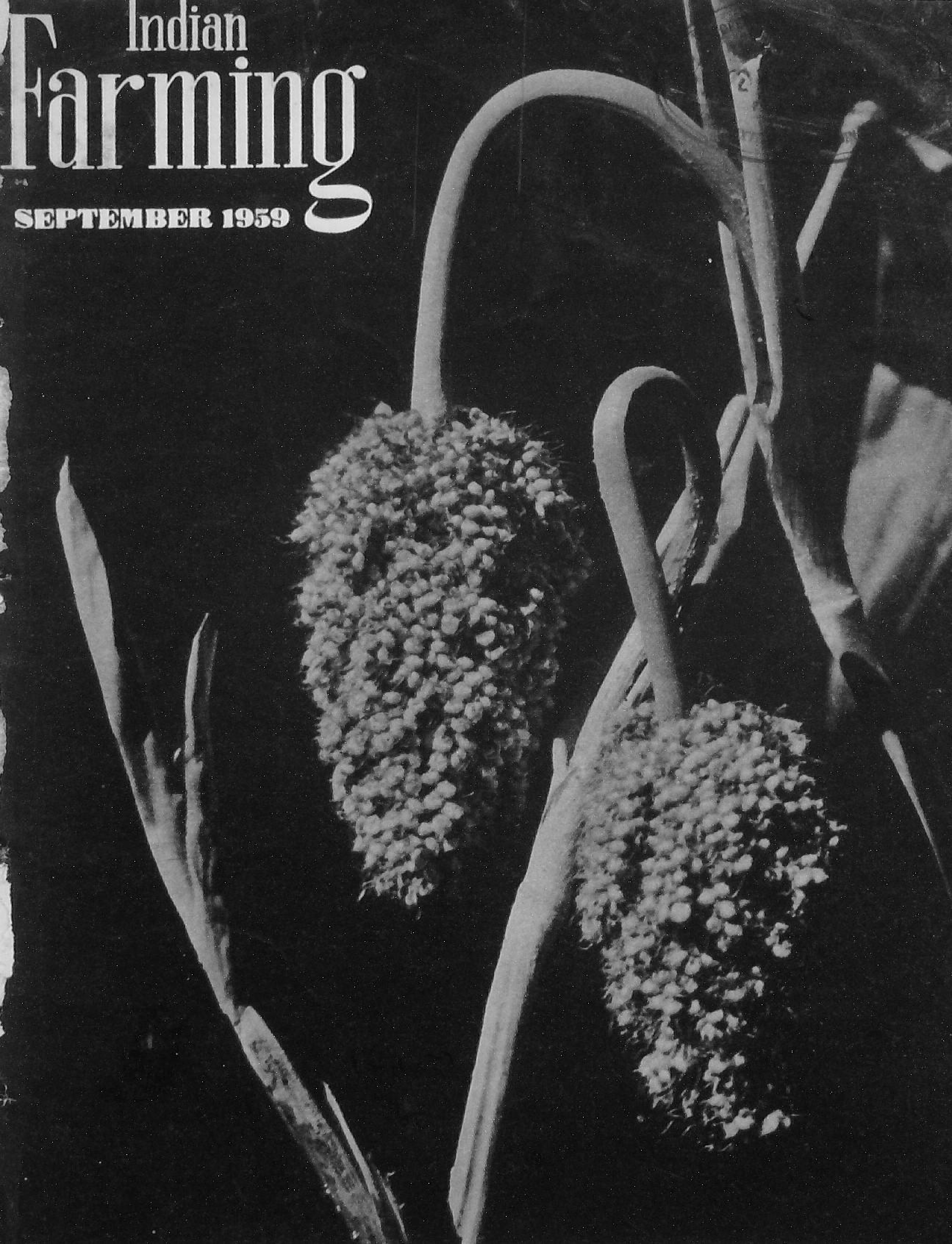
Indian Farming

SEPTEMBER 1959



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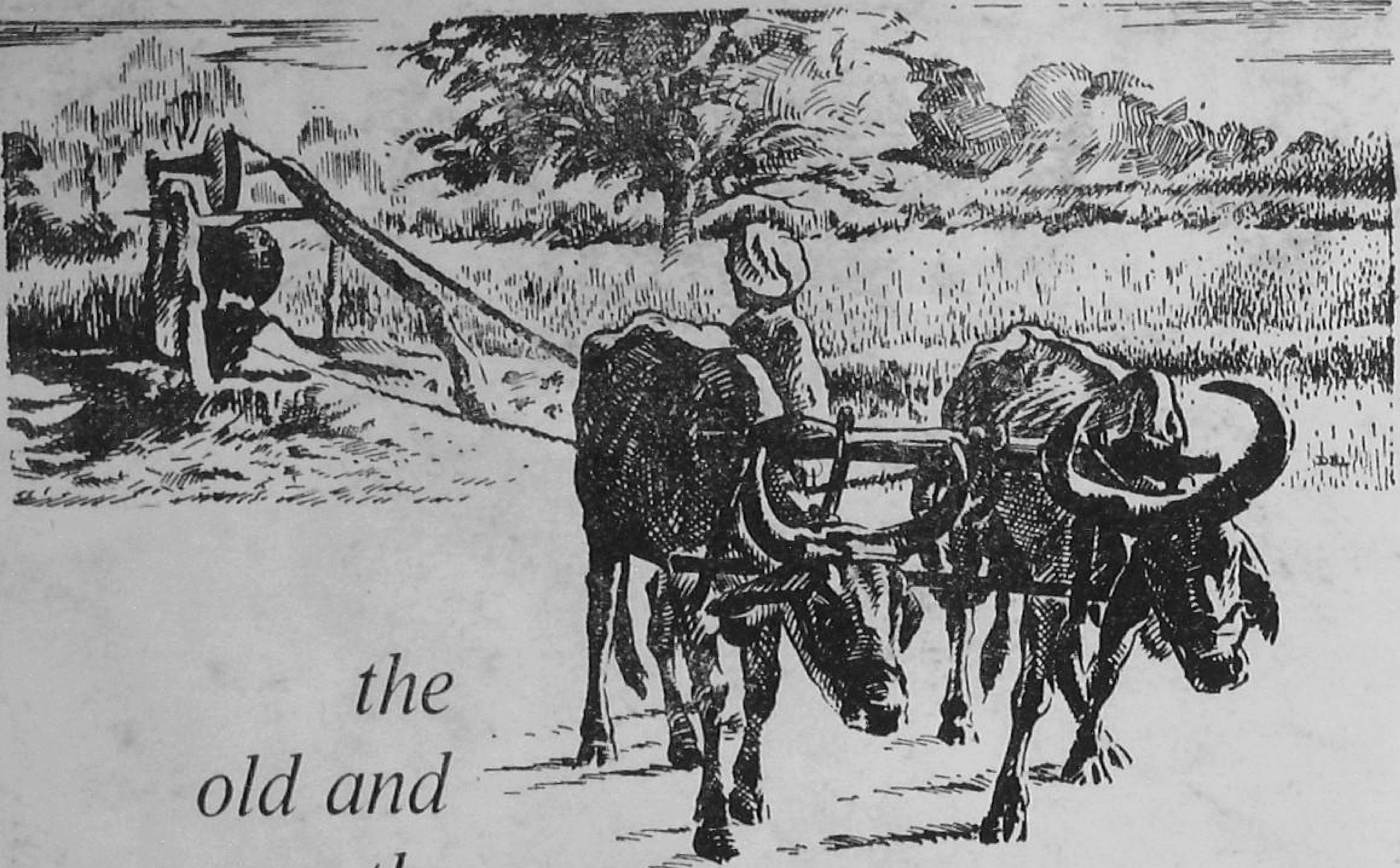

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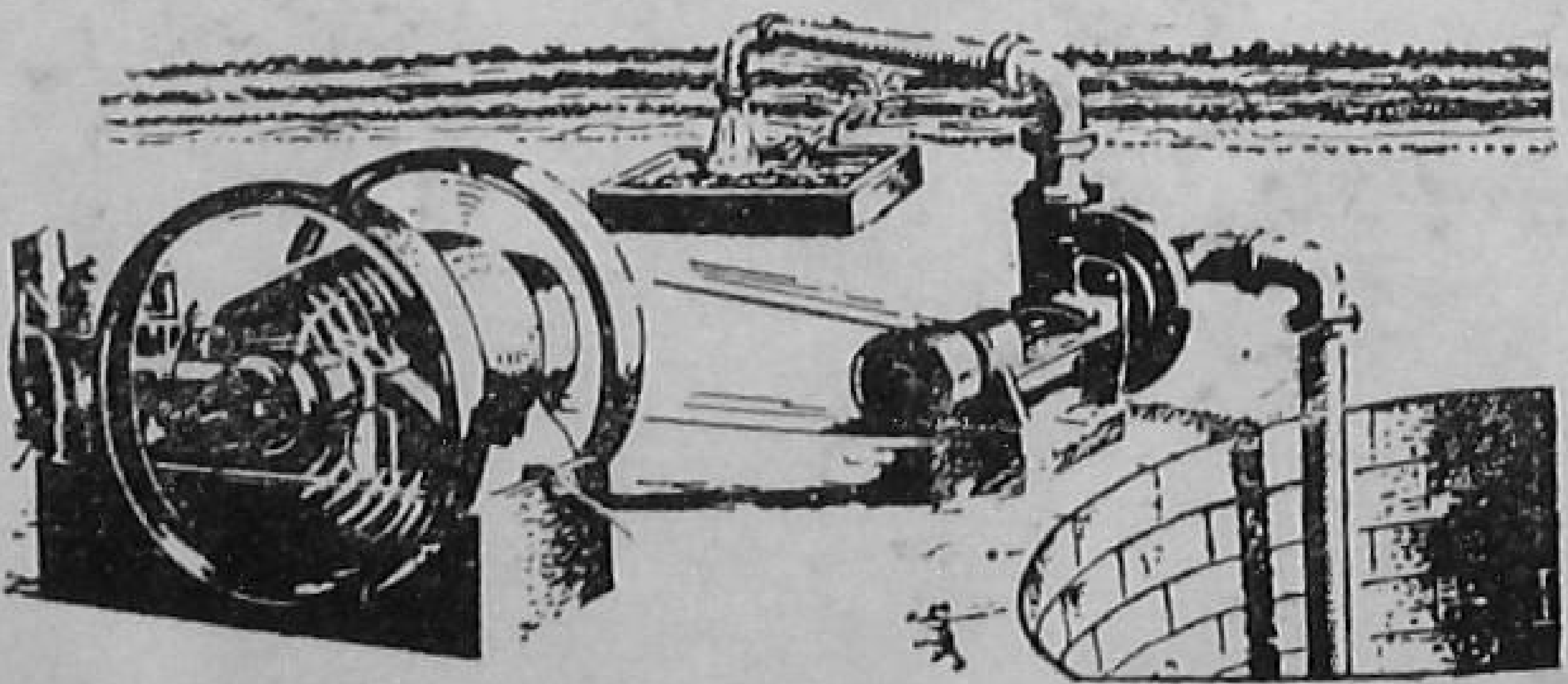

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MEETING THE FOOD CRISIS

A 14-MAN Ford Foundation Team on Agricultural Production has visited India and given its verdict on the country's food problem. The conclusions arrived at by the Team and the facts and analyses on which it has based them, are contained in a 260-page Report recently published by the Ministries of Food and Agriculture and Community Development and Co-operation. Certain major proposals on how India could possibly meet its food production crisis emerge from this Report.

A MINIMUM price for their foodgrains should be assured to cultivators in advance of the planting season to give them the necessary incentive to invest on fertilizer, better implements, improved seed, or any other expenses necessary to increase production. Then, there should be a market within bullock-cart distance that will offer the guaranteed price when the cultivator has to sell.

A PUBLIC works programme for projects requiring primarily hand labour, such as contour bunding, land levelling, surface drainage, irrigation wells and tanks, is suggested for the unemployed and underemployed in the villages, who represent a waste of resources.

FULLER use of manure, compost and green manure is commended; but as these can substitute for only a small fraction of the chemical fertilizer needed to meet the Third Plan food targets, benefits from irrigation, bunding, improved seeds and other facilities can only be realized with more stress on procurement of fertilizers.

TECHNICAL assistance to cultivators for making a better use of available water should be extended. More emphasis should be placed on irrigation projects which will yield rapid returns in food production, such as tubewells and shallow masonry wells. Drainage improvement should be given a high priority as, in this way, millions of acres could be reclaimed and made productive.

THOSE crops and those areas in each state should be selected which have the greatest potentialities for increased production. Efforts to stimulate food production should be directed more intensively to rice and wheat which make up more than half the total foodgrains produced. With hybrid maize, India could make significant progress in foodgrain production.

LAND ceilings and other land reforms should be settled as quickly as possible. Firm plans should be formulated immediately to schedule the completion of consolidation of fragmented holdings, with improved co-ordination. To make the co-operatives strong, Government must be prepared to provide loans and to assist in the development of capable management. Production loans should be advanced on the basis of expected crop-yield and repayment ability instead of land security.

ANIMAL population competes with the human population for the products of the land. A tax policy which makes maintenance of useless cattle a burden on their owners, confinement of all bulls and castration of bulls not kept for breeding, measures to control open grazing, establishment of desiccating plants to process fallen animals (with incentive payments to owners who bring in fallen cattle) are the steps recommended.

THESE, in short, are the highlights of the Report. The Team repeatedly emphasizes that there are no simple solutions to India's food production problems, and no two or three easy steps can deliver the goods. It, however, feels confident that it is *within* the capacity of India's people to meet the great crisis before them.

Shri Mohan Singh (*left*) and Shri Rattan Singh have something to discuss about the hybrid maize seed they produced last year. Seen below is this year's seed-crop, one month old

by
Harkirat Singh

Jugiana's Big Business—Hybrid Maize Seed

THE distinguished role that General Mohan Singh played in organizing the Indian National Army is quite well-known. What is perhaps not so well-known is that he is the man behind Jugiana's colossal "project hybrid maize seed" which was recently in the news. A small village six miles from Ludhiana in the Punjab, Jugiana turned out 1,600 maunds of a new hybrid maize seed from 46 acres in February this

year—by co-operative effort. Almost all this seed was bought up by the State Government for distribution to farmers.

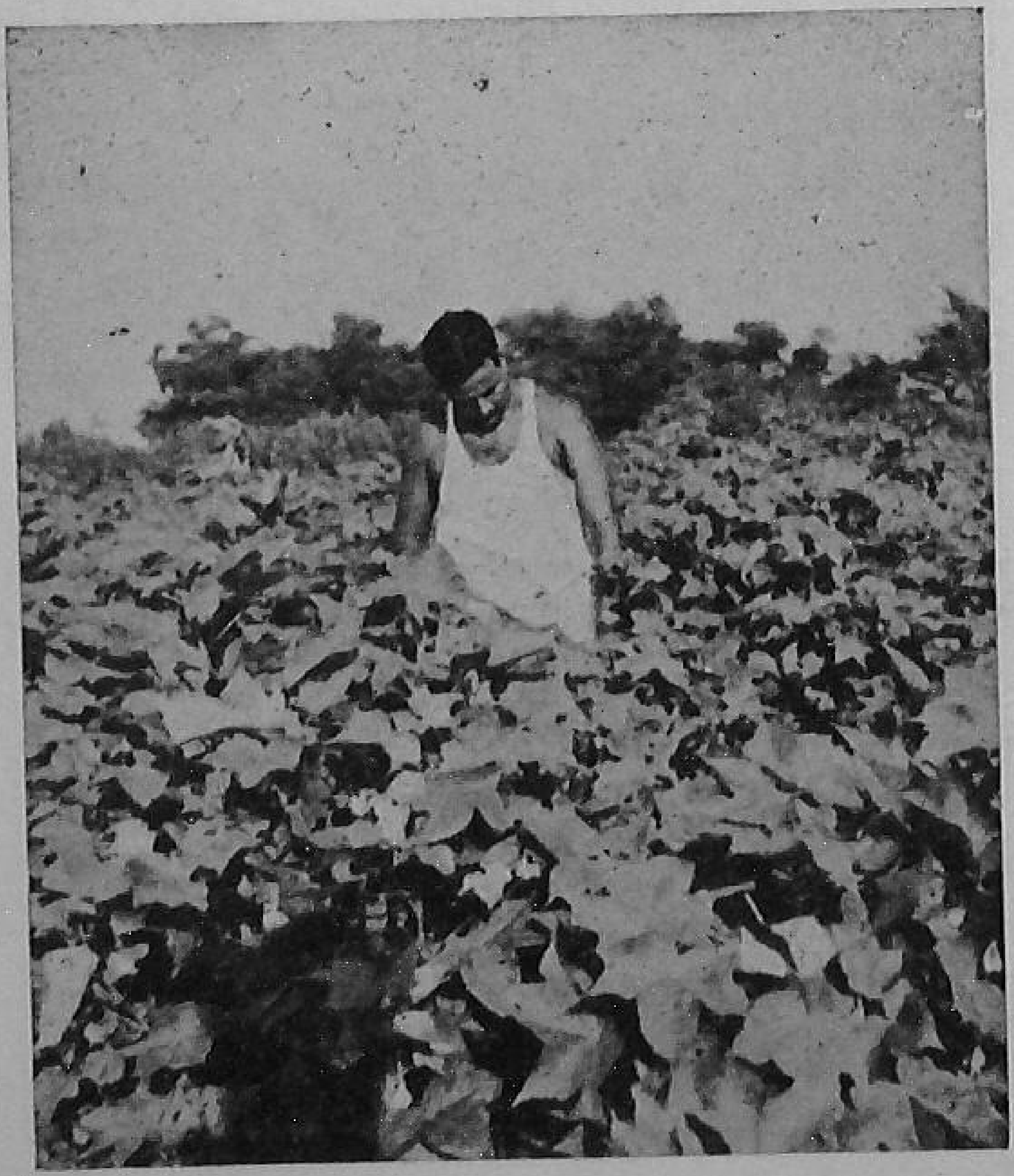
It was in 1951, when the State Government sponsored the Jugiana Co-operative Garden Colony Society under its Garden Colonies Scheme for rehabilitating displaced persons from West Pakistan, that Jugiana first hummed with co-operative activity. The Society certainly did well in electing a man of the organizing calibre of Shri Mohan Singh as its President ; for, since then, it has not looked back.

The membership of the Society is [illegible]5 families, each owning 17 'standard' acres, but "practically pulling together as one family," as Shri Mohan Singh, on whom I called recently, put it. He recalled, "When the site was occupied, to put it mildly, sand-dunes ruled and weeds prospered over it." I found it hard to believe, for before my eyes was a 'well-fed' land bearing nice *malta* trees and a lush young maize crop. He added, "I have lost count as to how many cartloads of compost and tank-silt and how many green manure crops have gone into it." That explained.

How Jugiana embarked upon hybrid maize seed production, is an interesting story in itself. Shri Rattan Singh, the Secretary of the Jugiana Society, got a chance to go to America in 1957 as a member of a farmers' group. There, it seems, he picked up intense interest in hybrid maize, for he saw in it double, and even treble, yields. He devoted almost all his time in that country to observing and studying the technique of growing double-crossed hybrid maize seed. He was particularly fascinated by a variety named *Illinois 1656*, which has bolder and richer grain also. And, that is the variety Jugiana is disseminating.

Rattan shows me how a corn-planter is used

Cotton, once the main crop of the colony, has lost its place due to frequent disease and jassid attacks. However, it is still grown in some plots in a bid to save it with the help of insecticides.



Back to Jugiana, Rattan mooted the idea that they take up seed production of the variety on a business scale. A meeting of the members was called to discuss the matter. Reluctance was visible, due to the novelty of the venture. It was then that the persuasive Mohan Singh sprang to action: he guaranteed compensation from his personal pocket in case of failure. Rattan offered to give all the technical guidance to everybody. The battle was ultimately won.

RISKY PROCESS

Explaining to me "the complicated and, at times, risky process" of hybrid maize seed production, Rattan told me that the crop was sown after berseem (even wheat was all right, he added). The first ploughing, five to seven inches deep, was given with a tractor at the end of April, followed by another tractor cultivation about a week later. Then, in the first week of June, the *sohaga* was worked, and another two tillings were

given. Farmyard manure was then added at 12 to 20 tons per acre; another cultivation immediately thereafter completed the land preparation by about 20th of June.

A fertilizer mixture, containing two hundredweights of ammonium sulphate, one hundredweight of urea, two hundredweights of superphosphate and one hundredweight of potash, was drilled before sowing in the first week of July. The seed was drilled in lines 2½ feet apart, two rows of the "male" parent to six rows of the "female" parent, maintaining a distance of nine to ten inches between plants.

CORN-PLANTER

In certain fields, the corn-planter was also used, and the seed sown in hills 2½ feet apart at three seeds per hill. Care was taken that the seed did not go less than 1½ inches deep or deeper than three inches. "The seed planted with the planter germinated better," observed Shri Rattan Singh.

When the plants were eight to nine inches tall, 'Endrex' was sprayed once to avoid borer attack. "We are pioneers in the area in adopting modern plant protection measures like spraying of crops," he hastened to inform me.

Thereafter, the crop was well cared for. It was given four to six hoeings—the first three deep and the remaining three, shallow. Irrigations were adjusted, keeping an eye on the rainfall. When the plants were about knee-high, two hundredweights of ammonium sulphate per acre were applied again. From the time the crop was 1½ months old, timely irrigation was the thing most looked after.

TEDIOUS PART

"With flowering came the most tedious part of the job," emphasized Rattan. He then explained to me that the tassels of all female plants were pulled out and thrown away before they could shed. "On the timely pulling out of the tassels," he said, "depends the ultimate success."

When the cobs were ripe, that is, when they drooped down (very unlike our *desi* maize), cobs from the male plants were harvested first and kept separately to avoid mixing up with those from female plants from which the hybrid seed is obtained.

SMOOTH WORKING

Encouraged by its very first resounding success, the Society is continuing with the project this year, too. To ensure a smooth working, the raising of the crop is entirely left to individual effort. The Society steps in only when the members have brought their produce to the common premises. A representative sample is taken from each member's lot for moisture test, it is weighed and the approximate net weight of grain that would be left after drying and shelling, calculated. It is recorded, because the member has to receive the payment accordingly.

Only thereafter the lots are mixed together, and the seed dried. Drying is done in a drier of 300-maund capacity worked with diesel burners, leaving only 15 per cent moisture in the seed. After shelling, winnowing and grading (with the help of screens) insecticide is mixed with the seed, and it is bagged, properly labelled and stored.

Production of hybrid maize seed is only one aspect of the Society's activities. Raising of fine orchards of *Blood Red maltas* and choice varieties of mango, is another. A modern poultry farm and a dairy are in the experimental stages. Yet an important item on the future programme is production of vegetable seeds on a commercial scale.

"So to appreciate our programme fully," smiled Shri Mohan Singh, "you have to come here again when the Colony has spread its roots deeply into the ground."

ECOLOGY COMMISSION TO MEET

The Commission on Ecology of the International Union for the Conservation of Nature and Natural Resources is meeting at Warsaw from 14th to 29th June, 1960.

Discussions will be centred on the impact of Man and Modern Technology on Nature and Natural Resources; management of Wild Grazing Animals in Temperate Zones and its Relation to Land Use; and Ecological effects of the Biological and Chemical Control of Undesirable Plants and Animals.

Any scientist desirous of presenting papers on any of the above themes may contact Dr. G.S. Puri, Member of the Commission on Ecology, IUCN, Botanical Survey of India, 7 Koregaon Road, Poona 1, India, for further information.

Two Pests That Bother Mesta And Roselle

by
N. Dutt
Jute Agricultural Research Institute
Barrackpore, West Bengal

THOUGH the two Hibiscus fibre crops, namely, mesta (*kenaf*), or *Hibiscus cannabinus*, and roselle, or *Hibiscus sabdariffa*, are grown in certain areas of north-east India in the neighbourhood of jute during the same season, yet neither of them is susceptible to any major pest of jute. But then, they have their own serious pests: *Agrilus acutus*, or the spiral borer of mesta, and *Phenacoccus hirsutus* of roselle, which bring down their yields considerably.

These two fibre crops are known to growers and to the trade as "substitute" fibre crops. This is because their fibres can replace a certain percentage of jute during spinning in the mill. The acreage under these crops in the Indian Union is estimated to have gone up from 0·3 million acres in 1947 to 0·8 million acres in 1958, because they can be grown on poor soil considered unsuitable for jute.

The spiral borer is so called because of the spiral nature of the tunnel it makes beneath the bark around the woody tissues of the stem. It was introduced into the country only recently, in 1950, though it was first reported from the Dutch East Indies as a pest of Java jute (*H. cannabinus*) as early as 1922. By now, it has established itself as the most important pest of mesta. It seldom causes damage to the immature crop.

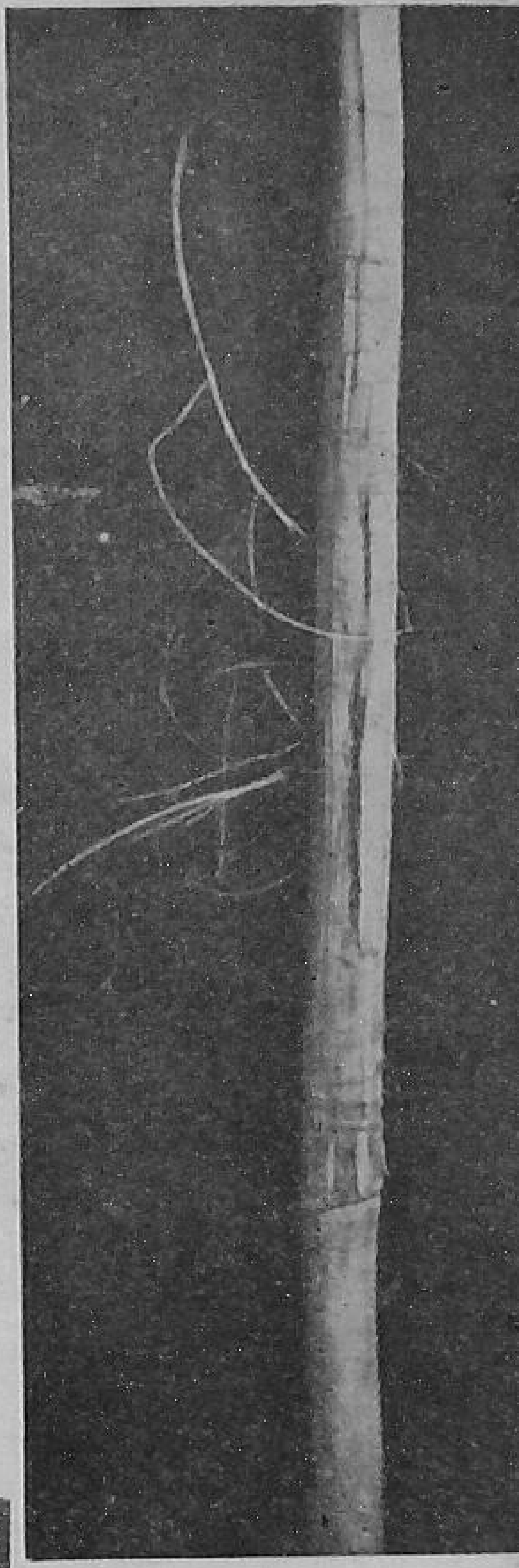
GALL FORMATION

In the affected plants, the course of the tunnel made during the later life of the larva can often be recognized by a slight swelling of the tissues of the stem. Towards the end of the spiral, an elongated gall ranging from three to 30 centimetres is formed; galls nine to 15 centimetres are frequently met with. Only the mature borer larva is capable of inducing the development of the gall. Its last phase before entering the pupal chamber is, however, not associated with gall formation. Gall formation has been observed to be more common in plants six to eight feet high; the gall is mostly formed within a height of 1½ feet from the base of the plant, though it may also be found at a higher level.

At the level of the gall, the spirals are very closely cut. The stem becomes very weak at this point, and snaps when there is a strong gust of wind. Loss of plants at this advanced stage of growth is a severe blow to the grower, and the affected field presents a pathetic sight. The fibres of the inner layers at the level of the gall are also at times damaged by the borer along the course of the tunnel, and remain firmly embedded in the woody tissues of the gall, even after retting, and are lost.

Stems snap off at the gall level

A mesta crop severely affected by the spiral borer



Fibres of the inner layers get firmly embedded in the woody tissues of the gall

The borer larva does considerable travelling upward and downward, often through the entire length of the stem. The larva has no legs, is flattened in the horizontal plane, and is yellowish-white in colour, with a large prothorax within which the head is withdrawn. The last or the anal segment bears a pair of serrated chitinous (horny) protuberances. The adult beetles are fairly large, measuring seven to eight millimetres in length with a brilliant blue-green shine. On the forewings, there are two conspicuous band-like areas scattered with white silvery hairs. Two similar whitish hairy bands are also present on each side of the abdomen. The inner edge of each forewing is raised, while the outer edge is drawn out into a prominent point. The first three segments of the antenna (or feelers) are barrel-like and the others, triangular in shape.

The females may lay eggs anywhere on the stem, but more frequently at the nodal region below the leaf base. The eggs are more or less ovoid in shape, a little flattened, one millimetre to 1·2 millimetres in length and 0·68 to 0·76 millimetre in breadth, and are provided with flanges for a better grasp on the stem. The chorion (shell) is membranous and is provided with a number of special pores or micropyles.

The pest has been found to attack different indigenous and exotic types of mesta. Roselle, which remains in the field longer than mesta, is attacked particularly when the mesta crop has been harvested. Roselle is, however, less susceptible to the pest than mesta and the elongated gall is seldom formed; hence, there is almost no breakage of plants.

Borer damage to inner layers at the level of the gall

Even though the pest attacks the roselle crop, it fails to induce the type of damage it does in the case of mesta and, therefore, is a much less serious pest of roselle. It is of interest to mention here that sporadic incidence of the pest has also been noted in *olitorius* jute under field conditions, but no such incidence has yet been recorded in any of the *capsularis* types.

Of the six different varieties of mesta tested in field trials, *MT-15*, evolved at the Barrackpore Institute, was found to be the least susceptible to the pest; among the four varieties of roselle tested, *RT-1* of the Institute showed the minimum incidence.

It has also been observed that, by varying the sowing time of mesta and roselle, the incidence of the pest can be reduced. These crops when sown during the month of April get the highest incidence; this, however, tends to decrease gradually with a progressive shifting of the sowing time beyond April. The borer inside the stem can also be killed by applying 2·5 per cent "Metasystox" in water by the swab method.

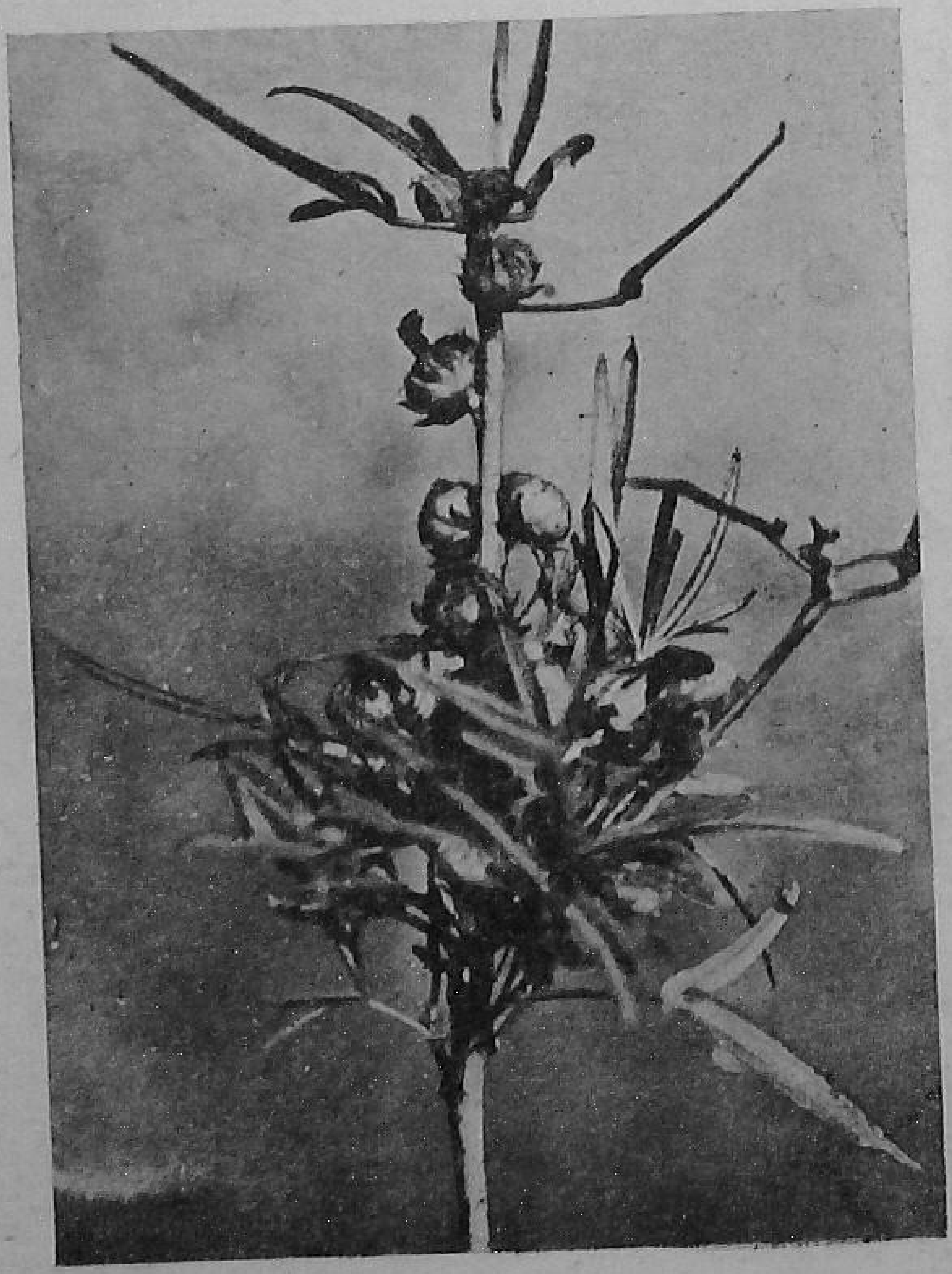
MEALY BUG

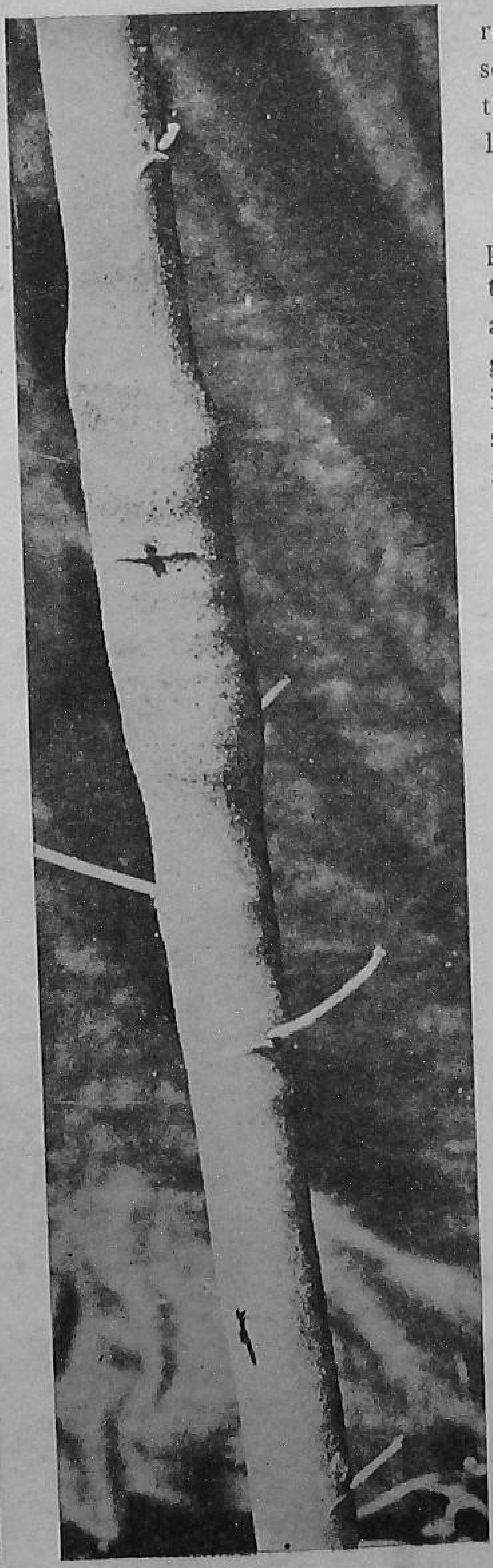
Unlike the spiral borer, the mealy bug *Phenacoccus hirsutus* mostly attacks the succulent apical (top) portion of the stem of roselle. In very young plants, a good percentage of the insects may attack the petiole (stalk) and the lamina (blade) of apical leaves. About ten per cent of the insects infesting the older plants may show a preference for the young capsules.

The pest was reported as causing serious damage to the roselle crop in 1948.

The affected plants become stunted due to the arrest of the vertical growth of the apical internodes; these shortened internodes swell up and develop a deep green colour. These conditions often extend to the leaf-petioles coming out from the nodes of the affected apical portion of the stem. The leaves arising from the closely placed nodes give the attacked plants a typical "bushy"-top appearance. In a severe attack, the plants may also die.

The mealy bug is responsible for "bushy"-top in roselle





A mesta stem showing gall induced by the borer

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In the field, the incidence usually occurs in small patches. On recovery early in the season, the growth continues through one or a number of apical shoots that may come out, giving the attacked plant, in the latter case, a "broom"-top look. In a seed crop, the pest sometimes attacks the young capsules and interferes with their normal development, which may result in crumpled pods with less seeds.

The nymphs and adult females cause injuries to the plant by thrusting their long and filamentous stylet fascicle (a tube-like structure for piercing and sucking) into the deeper tissues of the stem. It has been found that ten to 12 females can arrest the vertical growth of internodes and induce swelling and development of deep green colour in four to five days. If the plants are affected when 1½ months old, the average length of a stunted internode in the affected region is only 0.6 centimetre, as against the normal 3.1 centimetres. In the case of plants affected at 4½ months, the average internodal length in the attacked region is 1.1 centimetres as against the four centimetres in normal plants.

WINGLESS FEMALES

The females of the pest are apterous (wingless) and on maturity develop ovisacs, within which eggs are laid in batches. The eggs are cylindrical in shape, with rounded ends, and are pink in colour, each measuring 0.29 to 0.32 millimetre in length and 0.17 millimetre in breadth, on an average. Laying of eggs is usually completed in five to eight days.

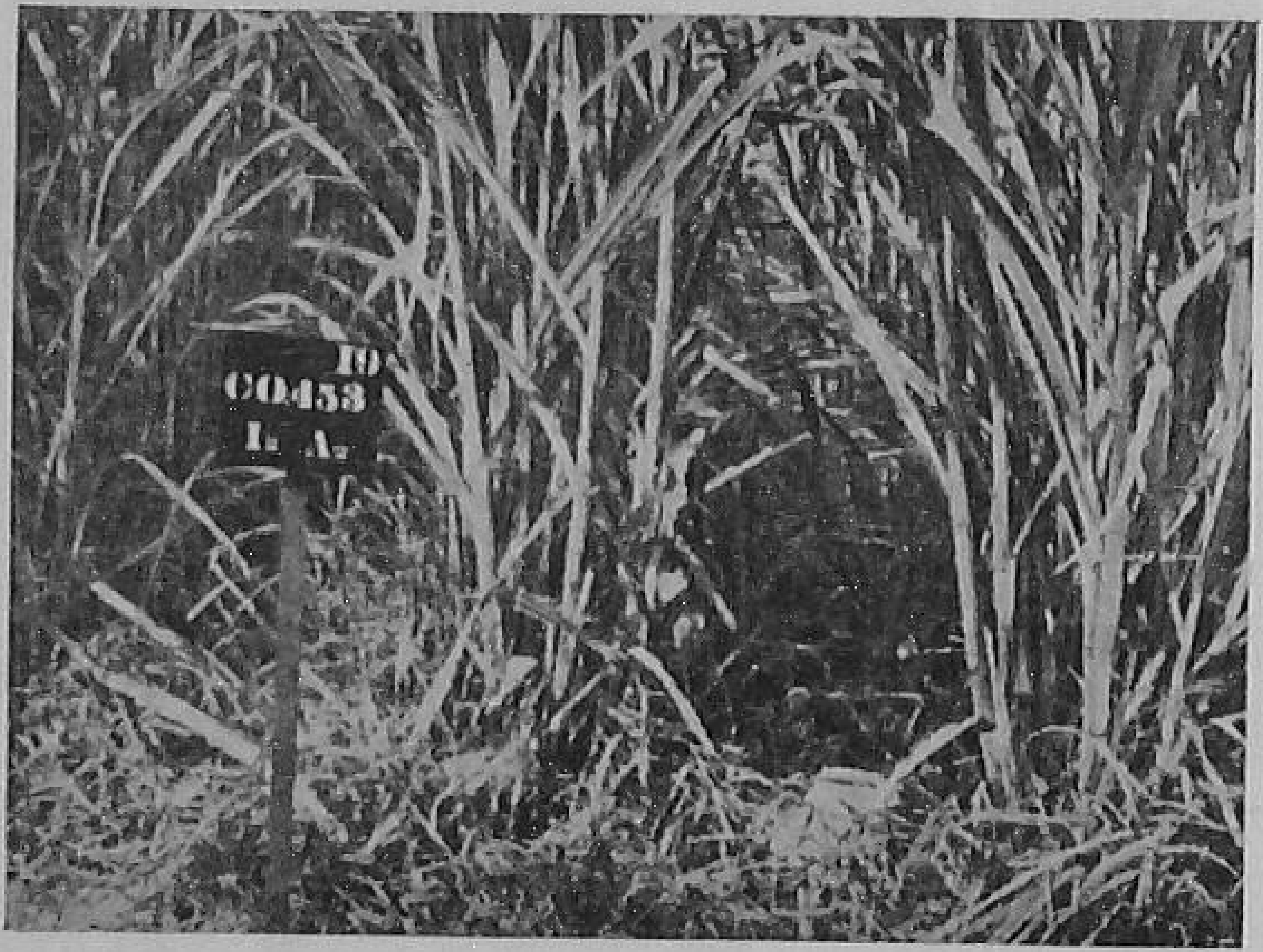
A fully-developed female is pinkish in colour and measures about three millimetres in length. Its anal tubercle bears a long and stout bristle, two small spines and few hairs. A ring round the anal orifice (opening) bears six setae (bristles). The legs have stout and curved claws with knobbed hairs.

The nymphs are light pink in colour and secrete mealy fibres and honey, and are often attended by ants. The male nymphs form cocoons from which the adults emerge. The male possesses no mouth-parts, but has two pairs of simple eyes, a pair of delicate wings, halteres (rudimentary wings) and a pair of long wax filaments supported by the anal setae.

Mesta is also at times attacked by the pest, but is much less susceptible in comparison with roselle. For control of the pest, 1.5 per cent nicotine sulphate and 0.02 per cent "Folidol" in water are effective.

When To Irrigate Sugarcane, And How Many Times

A larger number of irrigations and heavy manuring give a better crop (*right*)



This is what happens when proper hoeing and interculture are not done

by

J.G. Shrikhande *and* **H.P. Verma**

Main Sugarcane Research Station, Shahjahanpur

SHOULD your sugarcane crop fail to get enough water during March to June or between late August to October, the chances are that its yield will suffer. These are the critical periods in the growth and development of sugarcane. Between March and June (till the monsoon breaks) germination takes place and the root system and tillers are formed; from late August to October, the plant manufactures sugar. Any deficiency during these two periods reduces the yield permanently. Equally important for a good cane growth is an even rainfall during the rainy season.

The new and vigorous Coimbatore varieties require more water and manure than the indigenous varieties. With this factor in view, research is being conducted at the Sugarcane Research Stations at Shahjahanpur, Gorakhpur and Muzaffarnagar on the problems of irrigation in sugarcane under varying conditions, covering the main cane-growing regions of the State.

Experiments at Shahjahanpur to find out the number of irrigations required, and the quantity of water at each irrigation, clearly indicated that the increase in the yield was proportional to the number of irrigations given at 20-day intervals rather than to the quantity given at each irrigation. A minimum of five irrigations during the pre-monsoon period has been found necessary for a normal crop. With regard to the quantity of water, 3.5 acre-inches per irrigation gave better results throughout than either 2.6 or 4.5 acre-inches. Increasing the number of irrigations from three to six gave a 12.5 per cent increase in cane yield.

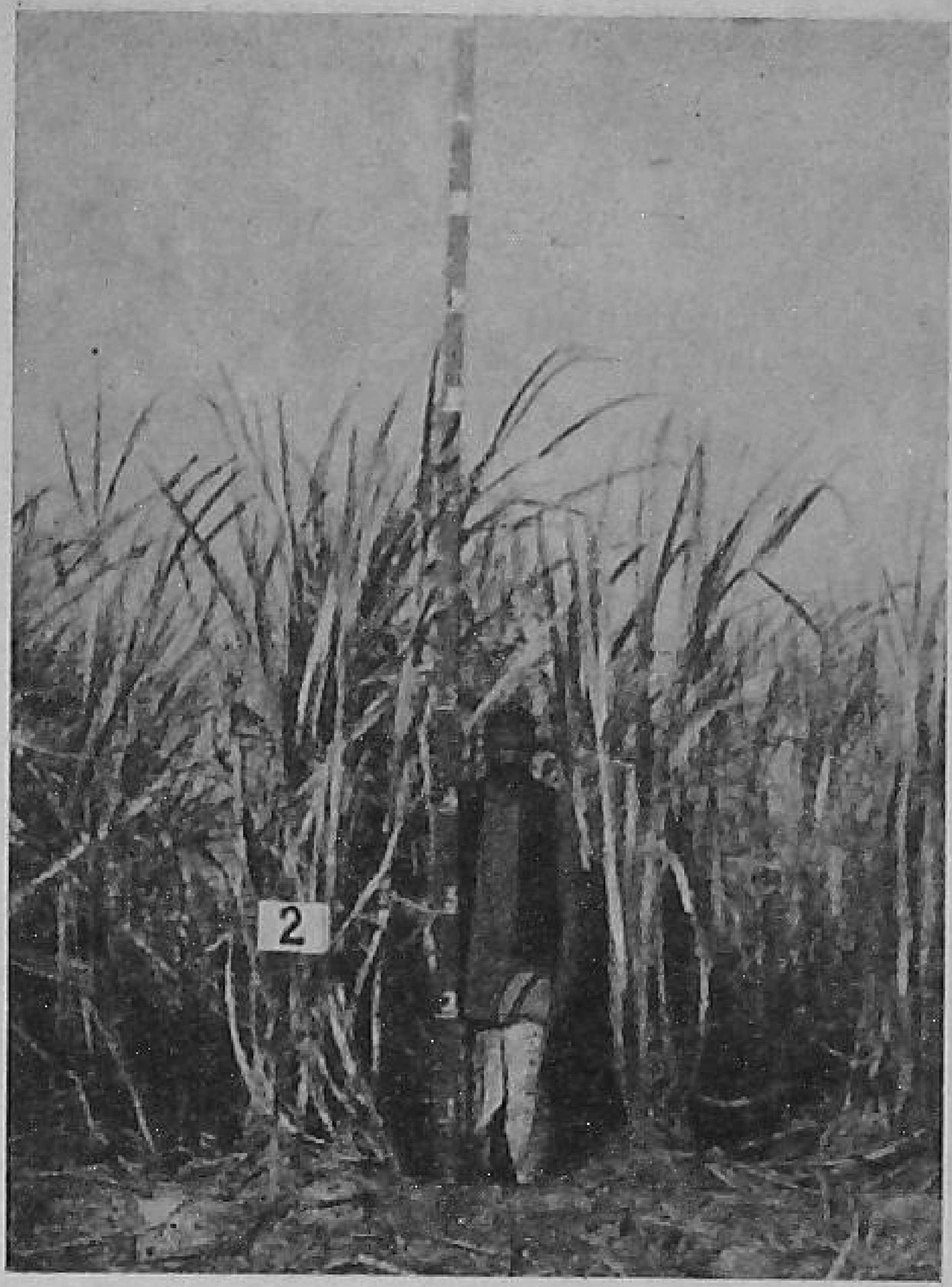
At Shahjahanpur, it has been shown that one irrigation in April and one in May are absolutely necessary for the good growth of the plant where irrigation facilities are poor. Humidity and soil moisture are very low during these months and lack of irrigation may cause wilting, drying and even injury, which adversely affect the final yield.

PLANTING TIME

An experiment to study the effect of irrigation before and after planting indicated that in the late-sown (April) crop, an irrigation given after planting resulted in higher yield, partly compensating for the loss due to late planting. February or March-sown crop was not affected by the time of irrigation. In the April-sown crop, there was a gain in yield of 55 per cent when an irrigation was given after planting, compared to an irrigation before planting.

Under Shahjahanpur conditions, irrigation at 20-day intervals from April onwards up to the onset of rains are found necessary for optimum yield. If, therefore, during the rainy season, gaps of more than 20 days without rain occur, irrigation becomes necessary. High rainfall and high humidity positively improved growth and resulted in higher yield. It was noticed that high humidity and moderately high temperature and a well-distributed water supply were important for optimum growth.

It was found that in years of normal rainfall, i.e., when there is about 40 inches of rain, post-monsoon irrigations raised the yield of cane slightly, but maturity



A poor crop: it received two irrigations

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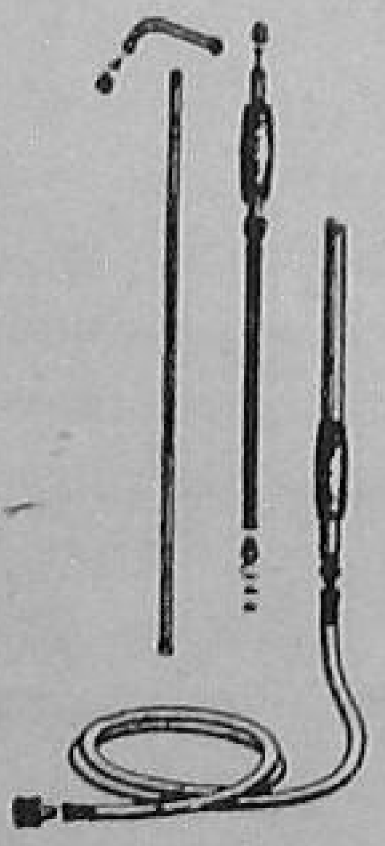

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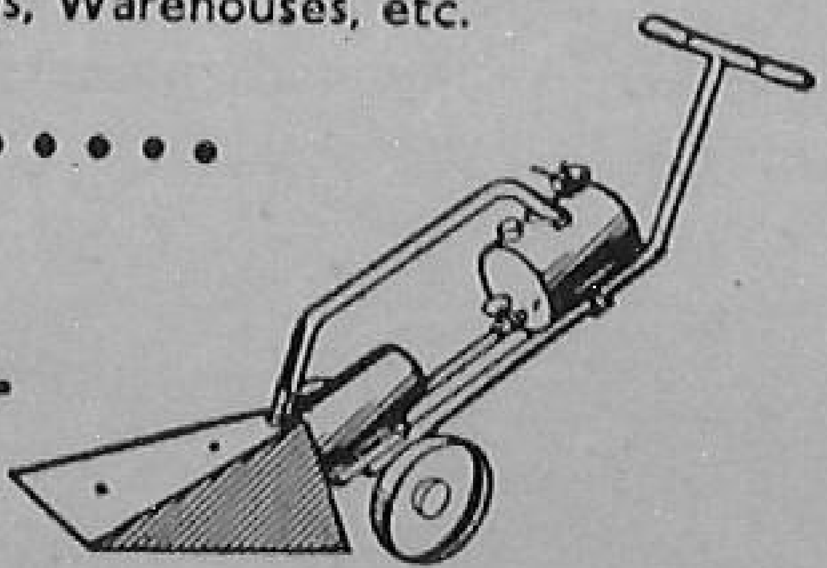

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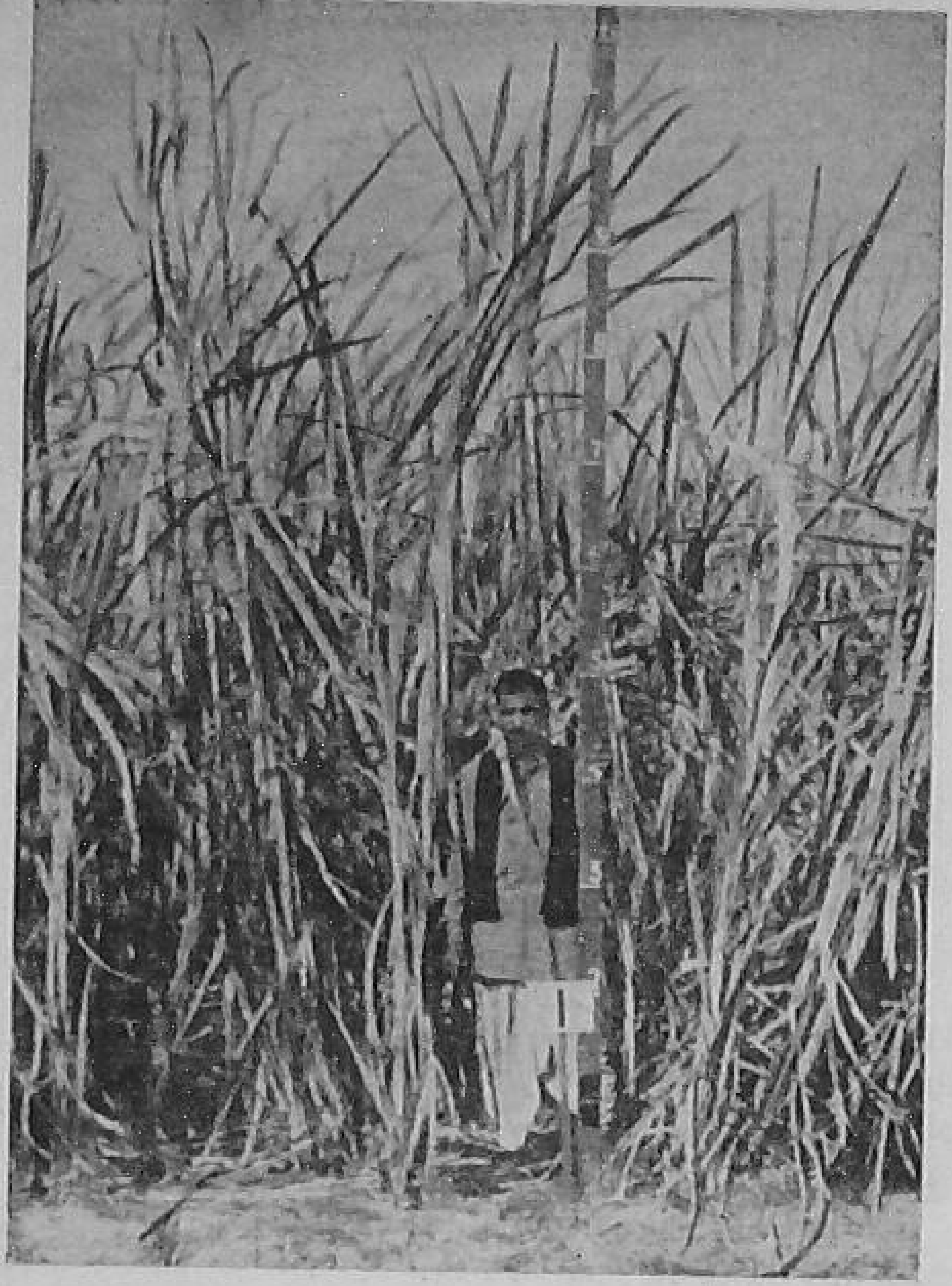


A normal crop: it received five irrigations

At the Gorakhpur Station, where the average annual rainfall is 50 16 inches, six irrigations along with 120 pounds nitrogen gave the most economic return. Thus, a total of 71.16 inches of water is needed for normal cane growth in this region.

Similarly, at the Muzaffarnagar Research Station, eight irrigations (five pre-monsoon and three post-monsoon) gave the best results. The average rainfall at Muzaffarnagar is about 32 inches and it, therefore, appears that about 60 inches of water are needed for normal growth.

Generally speaking, in areas with an annual rainfall below 40 inches, if long dry spells occur during the rainy season, additional irrigation can be given during the monsoon itself with advantage. However, with a given annual rainfall, the yield is better when it is evenly distributed than when there is sporadic rainfall with long rainless periods. Periods of excessive rainfall result in water-logging of the fields, and are harmful to cane growth.

was delayed, resulting in a lower sugar content. Irrigation in the post-monsoon period is useful only in years of deficient rainfall, particularly when the rain fails early in the season. A larger number of irrigations during the post-monsoon period depresses juice quality.

The inter-relation between water and nitrogen, the two most important factors in cane growth, was studied. The results indicate that there is a progressive increase in yield with an increase in the number of irrigations from three to nine. The yield also increased with levels of nitrogen, but the interaction between water and nitrogen was not significant. The highest yield representing an increase of 25 per cent was obtained with 200 pounds nitrogen and nine irrigations.

Increasing the number of irrigations at the 100 pounds nitrogen level revealed that for a normal crop six irrigations during the pre-monsoon period was optimal. Further irrigation at this nitrogen level proved uneconomical. A small deficiency of nitrogen could be made up to a certain extent by an increase in the quantity of water, and *vice versa*.

For a normal crop of sugarcane planted in spring at the Sugarcane Research Station, Shahjahanpur, where the average annual rainfall is 40.77 inches, about six irrigations are required, each consisting of 80,000 gallons (3.5 acre-inches), amounting to 21.0 acre-inches on the whole. Thus, a total of 61.77 inches of water is required for a normal crop.

DROUGHT RESISTANCE

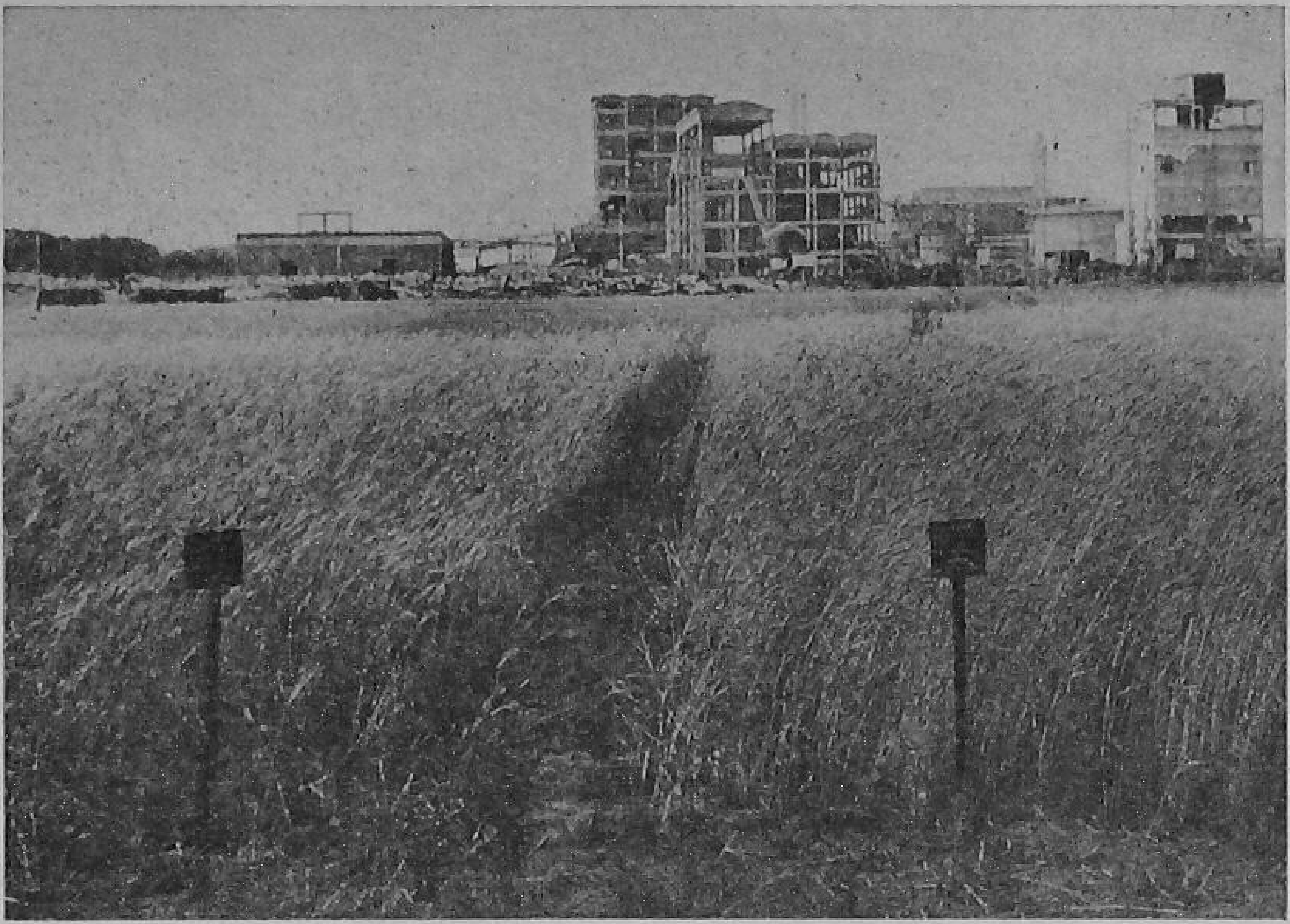
Cane varieties differ in drought resistance. A number of promising varieties were grown under deficient (two) irrigations and normal (five) irrigations applied during the pre-monsoon period. *Co.453*, *Co.S.510* and *Co.S.321* were able to endure drought better than *Co.622* and *Co.617*, and were thus able to utilize irrigations more efficiently. There was a significant drop in the yield under deficient irrigation in all the varieties.

The effectiveness of irrigation can also be increased considerably by reducing the loss of moisture from the soil surface after an irrigation has been applied. Experiments were conducted at Shahjahanpur with plots covered with cane trash or paddy husk to check evaporation and to suppress the growth of weeds. It was seen that soil moisture was lost more rapidly in open plots than in covered ones. The differences in cane yield were, however, more pronounced under deficient irrigation: in fields covered with cane trash, there was a gain in cane yield of 43 per cent over the unhoed and uncovered plots.

This method of covering the field with leaf trash may be profitably adopted in all areas with limited irrigation facilities. This will save at least two pre-monsoon irrigations and will result in cane yields comparable to areas with adequate irrigation facilities.

Without proper hoeing, weeding interculture, or drainage, etc., no amount of irrigation can profitably increase the yield or quality of sugarcane.

(CONTD. ON PAGE 29)



The crop on right received ammonium chloride; that on left did not

Why Not Try Ammonium Chloride?

by

P. C. Chaudhry

THERE is no reason why ammonium chloride should not be as popular as ammonium sulphate as a nitrogenous fertilizer. It contains 25 to 26 per cent nitrogen, as against 20.6 per cent in ammonium sulphate, and manurial trials have shown that it is not at all inferior to the latter, and is even better. It can now be manufactured economically as a co-product of soda ash. Its production on a large scale is also feasible in our country because we have the raw materials for it—common salt and coal—in plenty.

Ammonium chloride is suitable for all types of soils except acidic soils. Its use as a fertilizer was thoroughly studied at Rothamsted and Woburn in England between 1920 and 1930, and at numerous other places in Europe and America. It has been fairly well established that ammonium chloride is superior to ammonium sulphate for crops like barley, buckwheat, etc. In the case of tobacco, however, it has been reported to reduce the burning qualities of the leaf due to the greater uptake of chloride. The suitability of ammonium chloride for chewing tobacco is being studied at the Central Tobacco Research Institute, Rajahmundry, Andhra Pradesh.

During the past three years, many experiments have been carried out on government farms as well as on cultivators' fields well scattered over the different climatic and soil regions of the country, by the State

Agriculture Departments and Central Research Institutes. In all these experiments, ammonium chloride has come out on a par with ammonium sulphate for paddy, wheat, maize, *jowar*, *bajra*, cotton, sugarcane and jute. The results of some experiments carried out in Uttar Pradesh on wheat in 1955-56 and sugarcane in 1956-57 are given below.

Wheat

Treatment	*Yield in maunds per acre*			
	Banaras	*Barabanki*	*Meerut*	*Faizabad*
Control (no manure)	10.67	9.67	18.56	6.67
24 lb. N/acre as ammonium chloride	17.75	15.23	26.92	14.96
24 lb. N/acre as ammonium sulphate	15.92	15.23	26.71	11.12

Sugarcane

Centre	*Control*	*60 lb. N per acre as ammonium chloride*	*60 lb. N per acre as ammonium sulphate*
Khadda	408	465	497
Ramkela	450	506	491
Chuchali	154	160	144
Govt. Agri. Farm, Faizabad	452	485	450
Masodha Farm, Faizabad	757	769	786
Briswan	660	655	697
Gola	986	1,072	1,025
Neoli	603	558	698
Khurdia (Kichha)	812	856	842
Ramnagar (Kichha)	320	373	401
Scobara	497	585	571
Muzaffarnagar	512	644	549
Meerut	616	704	673
Mowana Kalan	872	1,077	934
Mean of 14 Centres	578	636	626

It is evident that ammonium chloride compares favourably with ammonium sulphate for wheat as well as for sugarcane.

Ammonium chloride has also given very promising results with paddy in Uttar Pradesh.

Similar results have been obtained in the Punjab with cotton, which has shown better response to ammonium chloride than to any other nitrogenous fertilizer. Experiments on cultivators' fields in Bihar show it to be better than other nitrogenous fertilizers for water-logged soils.

ITS MANUFACTURE

Owing to its high cost of production compared to ammonium sulphate and other nitrogenous fertilizers, the manufacture of ammonium chloride as a fertilizer did not make any headway in the past; nor was it listed as a possible fertilizer of economic value. But it can now be produced as a co-product of soda ash by the modified Solvay process, thus reducing the cost of production considerably. A brief outline of the process is given below.

Ammonia is made by combining hydrogen and nitrogen gases at a pressure of 6,400 pounds per square inch. The ammonia produced is reacted with brine, and the liquor is used for dissolving sodium chloride (common salt). The liquor obtained after the separation of ammonium chloride is further treated with ammonia and carbon dioxide (carbon dioxide is obtained by subjecting carbon monoxide to the action of steam and an iron catalyst). Sodium bicarbonate is precipitated, centrifuged off, and calcined to sodium carbonate (soda ash).

The main advantage of this process over the conventional method is that it needs only 1.25 tons of common salt per ton of soda ash, as against two tons required in the latter.

FIRST VENTURE

The ammonium chloride/soda ash plant of Messrs Sahu Jain at Sahupuri, costing over five crores of rupees, is the first of its kind in this country. It will produce 40,000 tons of ammonium chloride and 40,000 tons of soda ash per annum. Considerable progress has been made, and the factory is expected to commence production before the end of this year. Doubling the capacity of the plant is under consideration.

It has been estimated that the country will require a total quantity of 22.7 lakh tons of chemical fertilizer in 1959-1960. The indigenous supply is expected to be of the order of only 8.2 lakh tons. The demand for fertilizers is already on the increase. The paucity of sulphur and sulphur minerals is, however, a limiting factor for the cheap and sufficient production of ammonium sulphate in the country.

If, however, ammonium chloride is recovered in all soda ash factories for use as fertilizer, it would augment the indigenous supply of nitrogenous fertilizer and help step up crop production. This has already been done successfully in Japan.

How Yingchu Co-op Solved Its Problems

by
Tsui Hsi-yen

OUR co-op has 204 households with 1,074 people in all, and together we own 700 acres of land. It lies about ten miles north of the Yellow River.

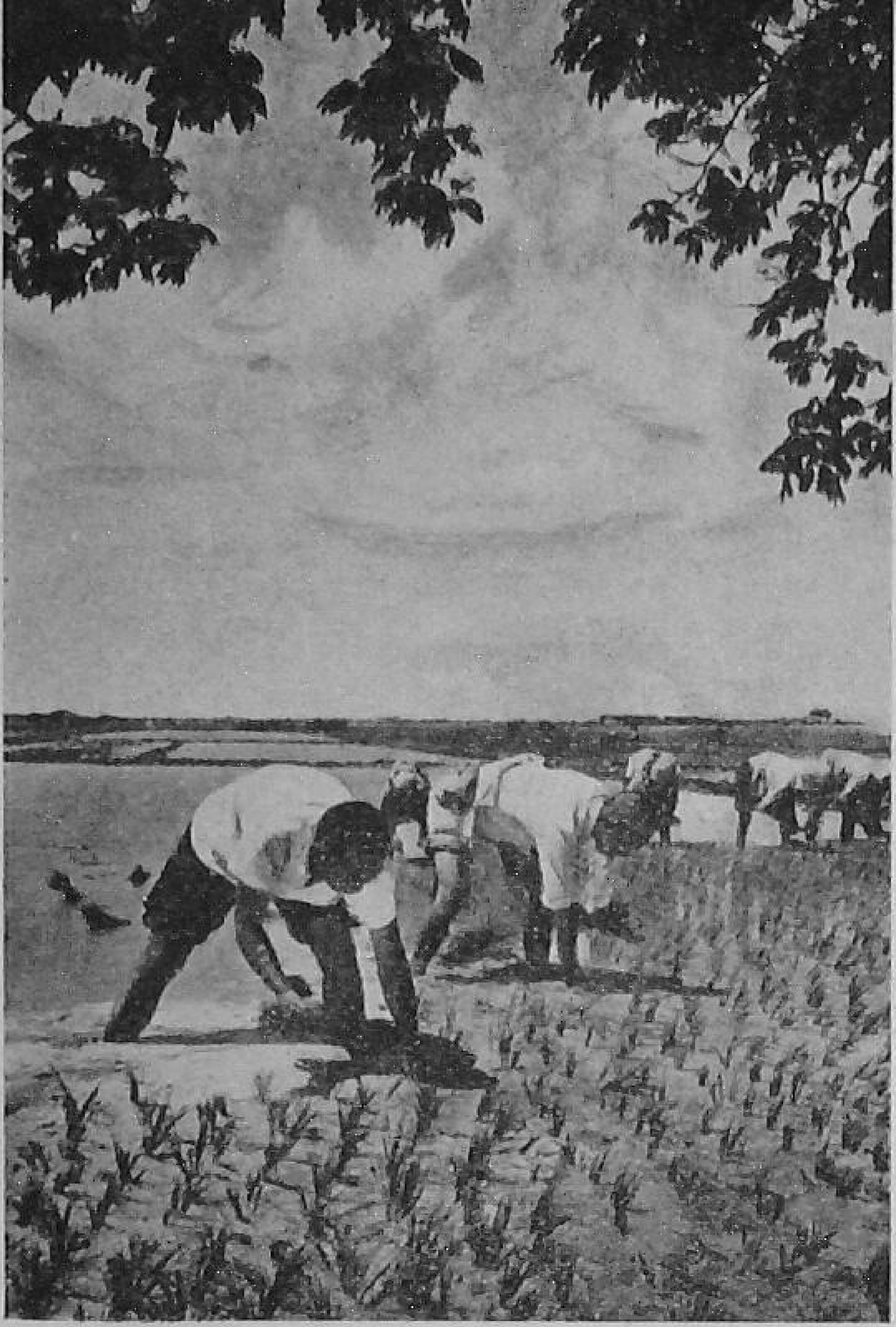
In our grandparents' time the land was reasonably fertile. But about a hundred years ago, a specially disastrous flood left a lot of sand on the soil which went sour and alkaline. People tried to overcome this by taking off the topsoil, but the result was that the land got lower, the flooding became worse and alkalinity increased. The worst year was 1942, when we had a drought followed by a plague of locusts. Every single year, except 1953, there has been some sort of calamity.

This canal was dug by members themselves

Winnowing a record wheat crop

We finally joined together in a big co-operative in 1956. There were bad floods again that year and four-fifths of our crops were damaged. But we managed to start 13 different kinds of subsidiary work, out of which we made enough money —117,000 yen— to keep everyone from hunger. We even sank some wells, built a few new houses and bought some new farm implements like double-share ploughs and insecticide sprayers.

That proved the worth of organization, though we were still in tight circumstances. But in 1957, after the early wheat was in, we had a still worse flood, the



Co-op members planting rice-shoots

biggest any of us could remember. Nine-tenths of our land was affected, and great damage was done. It was a real setback. And yet we turned it into our biggest victory.

A big discussion was held on how to overcome our difficulties without outside help. A call was issued to the whole membership in these terms: "The early autumn crop is flooded—let's sow a late autumn crop! What we've lost on agriculture we'll make up on sidelines. We'll ask neither loans nor relief from the country. Everyone must collect fodder for the livestock. Not one person, one draught animal nor one pig must go short of food!"

The whole membership responded with a will. As soon as the flood had subsided, everyone started digging channels to drain the water away. We worked three days and three nights without rest or sleep. We saved some of the sorghum and soyabeans by topdressing and harrowing, and replanted the rest of the land with turnips and sweet potatoes.

FULL OF IDEAS

Meanwhile, we stepped up the work on sidelines. The members were full of ideas for recovering our losses in this way. For instance, instead of consuming the sweet potato crop straight from the ground, we made it into potato flour and vermicelli. Some we ate and some we sold, and with the proceeds we were able to buy 110,000 pounds of grain. So a crop that would otherwise have lasted us only about two months became sufficient for nearly eight. It was the same with soyabeans. We had only 11,000 pounds for the livestock. Instead of giving them directly as feed we started pressing oil from them; the money from the sale of the oil bought 33,000 pounds of cattle food. We also fed the beasts on the bean residue.

However, this did not entirely make up for the food that had been lost. According to the government's policy, last year's calamity-stricken areas were entitled to receive sufficient grain from state stocks to make up a total allowance of 340 pounds per person. We were short of 125 pounds per head, and some of the members thought even that would not be enough.

We called a big meeting to debate this. Thanks to the fact that grain is government-controlled, we knew we would be able to buy from other parts of the country. Everyone realized that if it were not for this, many would have starved, as happened in 1942. But we all knew, too, that it had to be transported a long way. The previous year, when we had had to buy grain, the rice had come from Szechuan, maize from Heilungkiang right up in the north and sorghum from Kwangtung in the south. A lot of our members had already begun to think like "new peasants"—in terms of the country as a whole, instead of just themselves, and were concerned about the cost of all that transport.

THE WISE ONES

So the conclusion was, we'd better try and get by with as little grain as possible from outside. The members demanded that the management committee should think up ways of doing so. We put our heads together but no bright ideas emerged. Then we turned to the old folks, who'd had the best experience of getting through hard times.

We called a meeting of nine grannies and five old men, all known for their thrifty household management. They made over 40 suggestions for saving. There were, for example, the "three no-spills" advocated by one old man: don't spill grain when you are getting it from the bin, preparing it, or eating it (and specially train the children about this because they don't understand the labour that goes into growing food).

One of the grannies said she had a "psychological" method which she'd found very effective, and that was to use smaller eating bowls. Appetites actually vary, and if you served the food in half-size portions a

Co-op's newly-purchased grinder

"three-bowl" eater would often take only five smaller ones instead of six.

Another suggestion was that people should try and eat a bit less in the winter when there is not so much outdoor work, and thus save food for the big appetites that grow when spring the sowing begins.

On the strength of these and other suggestions, the members decided we should all ration ourselves voluntarily to four ounces of flour a day for a month, and make up the rest of our diet with turnips or sweet potatoes. After 35 days, we'd saved so much that some of the management committee got ambitious and proposed that everyone should go back to 12 ounces a day. The members turned this proposal down and said they'd take eight ounces. By the time the spring sowing began and everyone was out in the fields again, we had enough saved to last us through till the new harvest. From then on, everyone got one pound to 1½ pounds a day.

THE BIGGEST TASK

But our biggest task was to put an end once for all to the disastrous threat of recurrent flood and drought by carrying out basic flood prevention and irrigation work. Once again we launched a debate, hammering the whole matter out until everyone was convinced that we had the strength to conquer nature, and not just in one bad year but for ever. Like the rest of the co-ops in the country, we answered the call to dig ditches and channels, turn dry land into irrigated land and increase the yield on every possible acre. Besides collecting more fertilizer than ever before, it was suggested that we should start growing rice—which yields more than wheat or maize but which we'd never grown before.

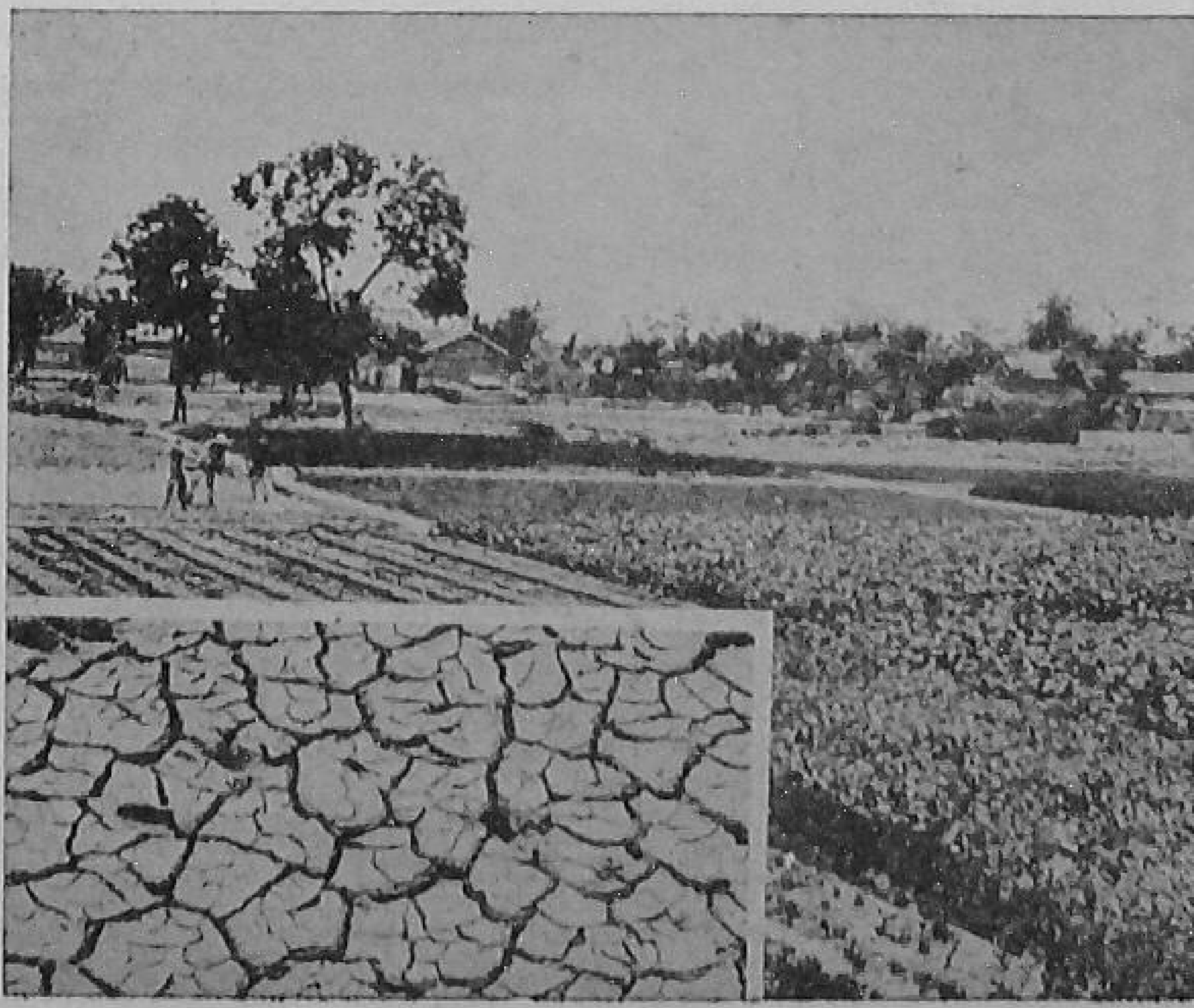
We got to work and with other villages in our area, dug an 80-yard wide canal from the Yellow River right up to our land, with 110 smaller ditches and canals leading off from it. Our villagers shifted about 104,500 cubic yards of earth. We had to find brick, cement and wood for sluice gates and locks, and all this material the members of the co-op contributed themselves. Altogether we built 90 installations on the water-conservancy network—all with our own efforts.

ENOUGH FERTILIZER

We collected and prepared enough fertilizer to apply 198,000 pounds to every acre of land—not quite as much as we'd aimed at, but still considerable. Each of the eight production teams in our co-op set up its own compost heap to make granular fertilizer. We got a lot of black mud from old ditches to spread on the fields too—and once the ditches were cleared, we began to breed fish in them.

To keep the three schemes running concurrently took a lot of organizing. We're not very experienced in leadership, but we found that it helped a great deal if you suited the jobs to the people. So we divided the work with this in mind, with about 200 of the younger ones on digging, the old folks gathering manure, about 80 people on the subsidiary lines like pig breeding and so on, and a few mobile ones in case of extra need, sickness or accidents. I must admit all the same, that the leadership we gave wasn't very advanced. Like me, the rest of the members of the management committee had had little or no experience of organizing a

The soil that failed to grow a blade of grass in the old days (*inset*) now bears luxuriant vegetable crops



big thing like a co-op. Several of us did no actual productive work at all.

This has been changed since the "Rectification Movement" during last autumn when all the members were invited to criticise their leaders, and did so —either in meetings or by "big-character posters." We saw that we'd actually become a financial burden on the co-op in some respects, so we made a thorough change in our ways. Since that time (with the exception of the two accountants) we all earn our work-points like the rest and what we do for leadership is regarded as voluntary duty. I'm looking after five of the draught animals now, and earning two work-points a day for it.

I didn't find it easy to change to this way of working. I'd got used to being in the office and only going to the fields to see how things were going and consult people about their problems. I was even apprehensive about getting my clothes dirty.

THE "DIRTY HAND"

I was lying on the bed one early morning when I realized that if I showed such shameful disregard for my responsibility, the co-op would not want me as its chairman for another minute. I jumped off the bed and ran straight out to the fields. We were fighting a winter drought at the time and one of the water-wheels was standing idle. I climbed up on it and started to pedal away like mad. Three members of one of the production teams were working not far away. I heard one remark: "The chairman's working!" Another commented dryly: "That's a new thing! "This made me heartily ashamed of myself. I answered, "I will make this new thing last."

What we learned this last winter was this. Leadership is not really a problem provided you consult people, listen to them, find out what they are thinking of and put all your weight on the positive side. If policy is correctly explained and fitted to the needs of the particular co-op or locality—that's where leadership comes in—the membership embraces it with both arms. There's no holding them back then.

The rice is coming on fine. We planted 470 acres of paddy this year, and the way things are going it looks as if we'll get 5,280 pounds from every acre. The government has sent three teachers to help us because we've no experience with this crop. One comes from the low-lying land near Tientsin, where the farmers used to suffer from the same problems of water-logging that we had in the past.

BETTER TIMES AHEAD

During 1956 and 1957, when we were still in great difficulties, we sank 36 wells and bought ten water-wheels and several double-share ploughs, insecticide sprayers, mincing machines for sweet potatoes and a rubber-tyred cart. That was small compared with what we shall be able to afford this year. We shall have four tractors, two rice-threshers, four steam-engines for pumping and other tasks and two mechanically-driven flour grinders. We shall buy 50 new draught animals as well. We've already got two brick-kilns and a small cement-mixing factory of our own. Before the year is out, besides our other sidelines, we shall set up a workshop for making mats, rope and other things from rice-stalks, one for processing grain, and one for repairing our farm implements.

Right now we've got a big chart in the co-op's headquarters, and each production team competes every ten days to see which is leading. At the top of the chart there's a painting of a sputnik; below that is a rocket, then a jet plane, then an aeroplane, a train, a truck, a rubber-tyred cart and, finally, an old-fashioned mule-cart. The team that reaches the sputnik gets the red banner for the next period. Everyone wants to compare and compete. No team wants to be the mule-cart. Mule-carts are too slow for us now—we're storming ahead to turn our northern plains into a "land of fish and rice" like the rich country south of the Yangtze.

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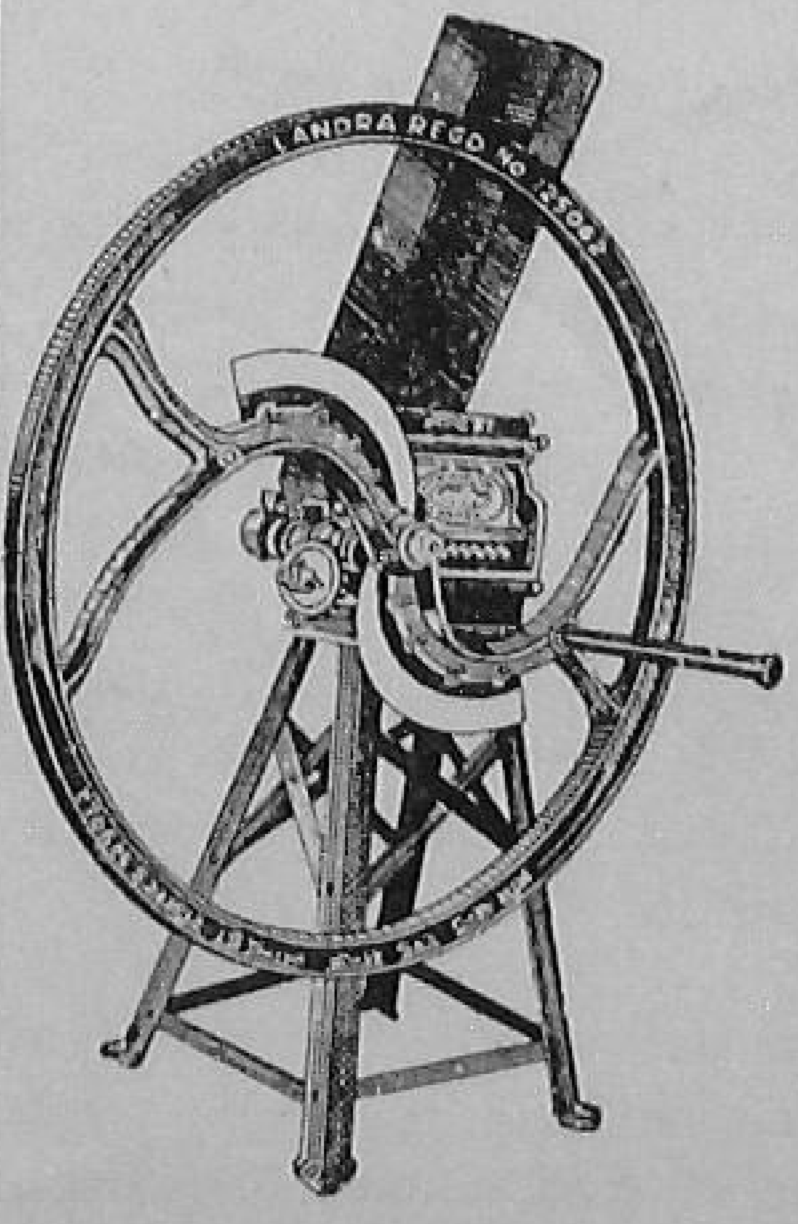

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MAKING D
MORE GARD

G.

A resident of Patel Nagar being helped in planting a *Gul mohar* sapling he has just bought from a team

A SPECIAL Extension Campaign to make the citizens of Delhi more garden-conscious was launched on July 11, 1959, by the Horticulture Division of the Indian Agricultural Research Institute, New Delhi. Teams of volunteers went round various localities in the city on bicycles, carrying seed-packets and technical literature for distribution. They told the householders how vacant land in front or at the back of their houses could be at once made beautiful and profitable by growing vegetables and flowers. The response to the campaign was truly spontaneous, for even in houses where very little space was available, the owners were keen on growing roses and chrysanthemums, for which heavy orders were booked by the teams.

The Institute (more popularly known as the Pusa Institute) has been producing high-quality vegetable seeds of improved varieties in large quantities and is also famous for its choice collection of roses and chrysanthemums. Fruit plants of known parentage and authentic quality are also being produced in the orchards of the Horticulture Division. The Division has already been helping enthusiastic home gardeners in their gardening. The campaign was launched to intensify and enlarge these activities and to enable the residents of Delhi to avail themselves more fully of the facilities at the Institute.

For the campaign, the staff of the Division—from officers down to *malis*, was divided into seven teams, each of which was equipped with a box containing packets of vegetable and flower seeds. Literature in popular language giving practical hints on vegetable cultivation and fruit-growing was also kept in readiness for distribution. Two *malis* along with tools and implements like budding and pruning knives, secateurs, *khurpis*, etc., accompanied each team for ready demonstrations of various garden operations like planting and pruning of fruit plants. A "pick-up" lorry laden with plants and manure accompanied the teams.

The campaign being inaugurated by Shri M. V. Krishnappa, Union Deputy Minister of Agriculture. To his right is Dr. M. S. Randhawa, Vice-President of the Indian Council of Agricultural Research, and to his left, Dr. B. P. Pal, Director, Indian Agricultural Research Institute, New Delhi

On the 11th and 12th July, the area of operation was confined to localities near the Institute, i.e., Patel Nagar, Rajinder Nagar and Karol Bagh. More localities in New Delhi like Ashok Road, Aurangzeb Road, Pandara Road, and areas in Delhi like Club

LHI CITIZENS

EN-CONSCIOUS

y

andhawa

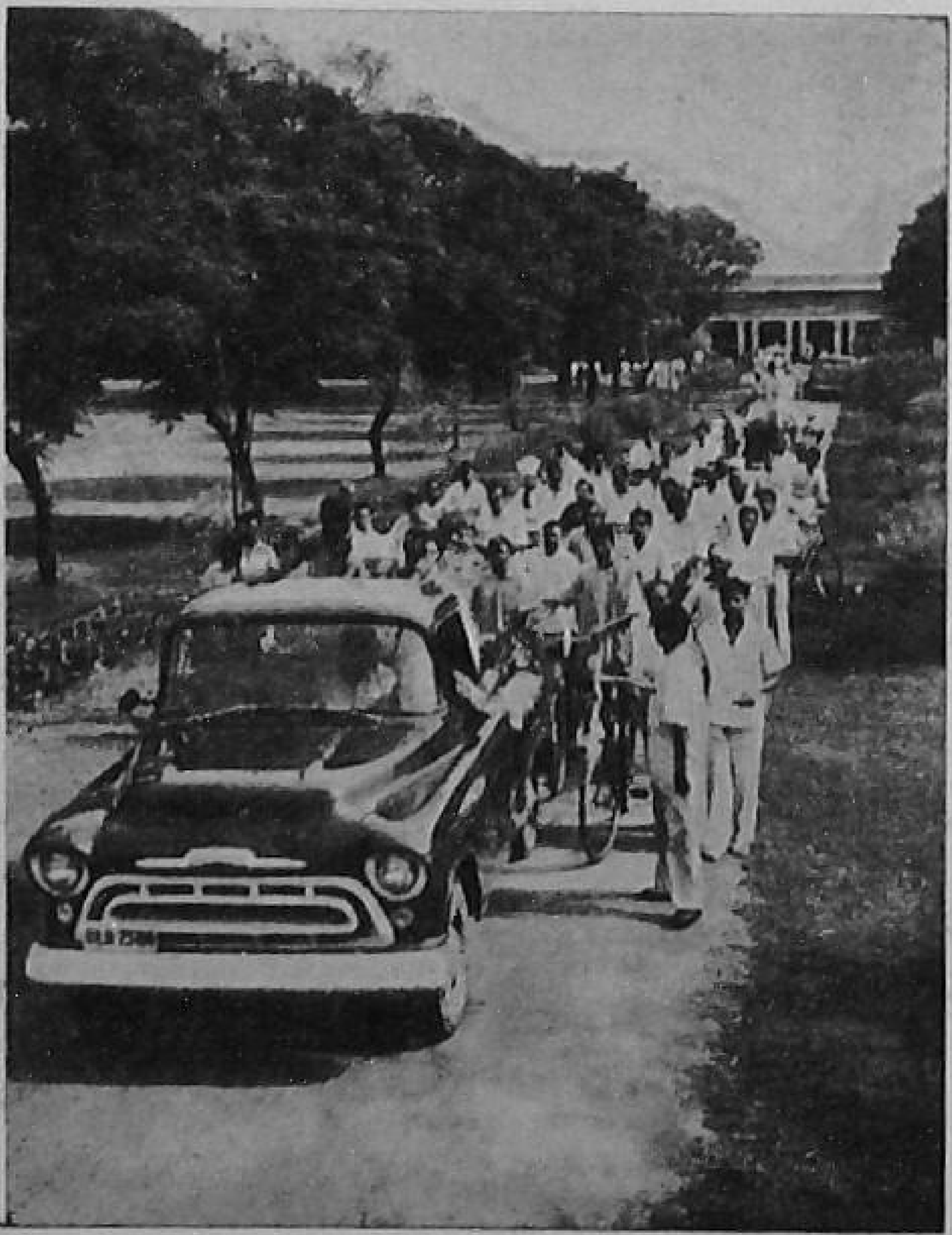
Road and Civil Lines, were covered on the 18th and 19th July.

The teams visited over 400 residences in Old and New Delhi. About 480 vegetable and flower seed-packets were distributed at nominal rates. At more than 20 houses, demonstrations of sowing of vegetables and planting of trees were given. In six newly-constructed bungalows, home gardens were laid out and the plant material was also supplied.

In all, the teams distributed and planted over 223 fruit plants and booked orders for about 1,561. Papaya,

Improved vegetable seeds had a ready sale

Teams leaving the Institute on their itinerary



malta, lemon and mango were the main fruit plants distributed; there was a heavy demand for the *Pusa Seedless* grape. The ornamental plants distributed and booked for numbered 94 and 212, respectively, chiefly *Gul mohar*, *Plumeria acutifolia*, *Cassia fistula*, Jacaranda, jasmines and Bougainvilleas.

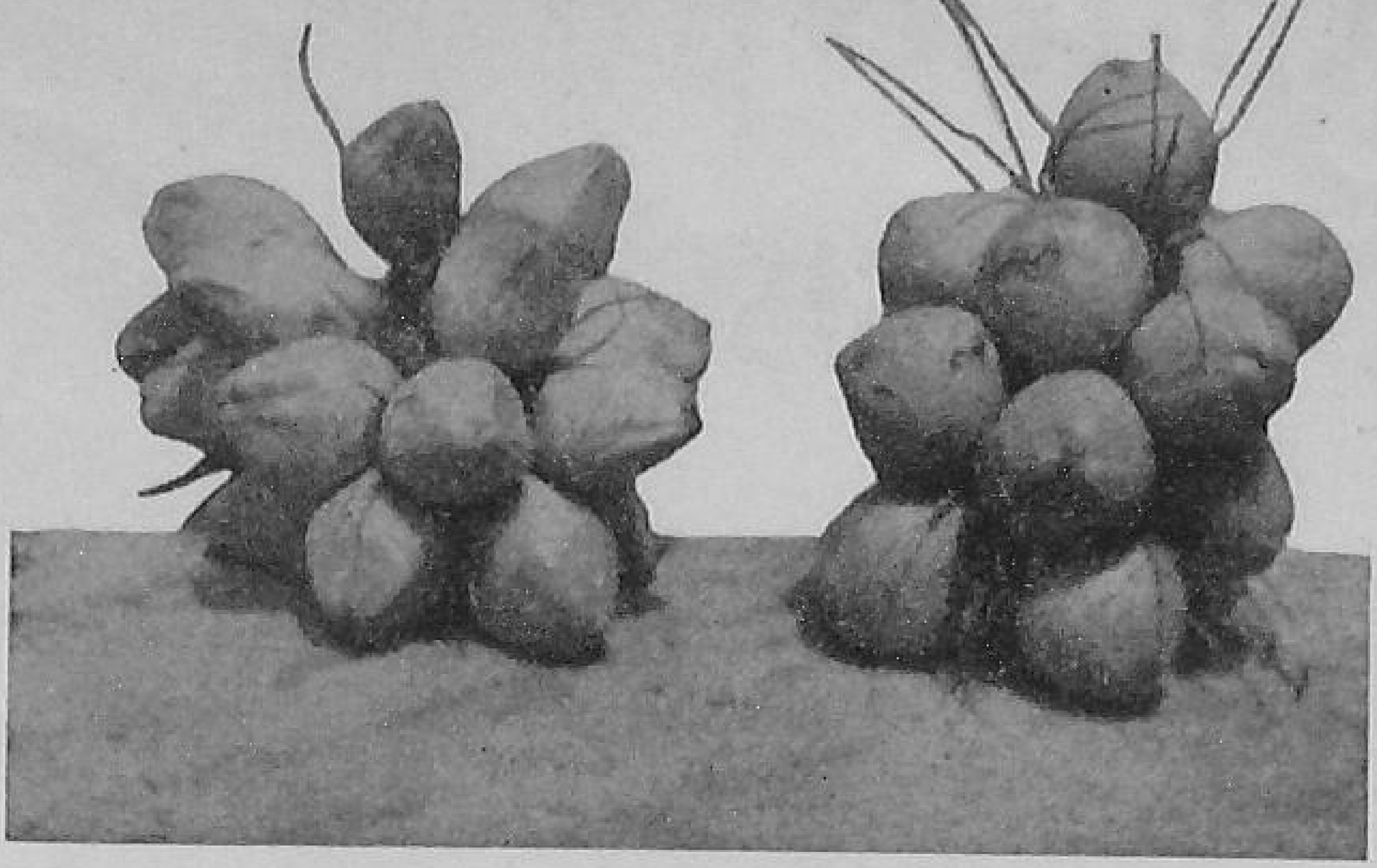
Technical literature, including I.C.A.R. bulletins on cultivation of vegetables and fruits, was distributed to a large number of interested people; catalogues with hints on cultivation of roses, etc., were also distributed free of cost. Over 1,600 technical bulletins and catalogues were distributed.

Useful suggestions were given to the house-owners on control measures for field rats, white ants, etc. Some general complaints and difficulties recorded during this campaign were non-availability of manures and fertilizers; difficulty in the supply of unfiltered water in East, West and South Patel Nagar and Rajinder Nagar—house-owners have to use filtered water instead, which is uneconomical; and the stray cattle nuisance.

Kulasekharam Farm Grows Dwarf Coconuts On Plantation Scale

by

R. Gopinathan Nair
Central Coconut Research Station, Kasaragod



The Banjar green dwarf yields oval nuts (*left*), **the Antara green dwarf, round** (*right*)

A RARE spectacle of dwarf coconuts grown on a plantation scale in India is provided by the new Ambadi Estate, Kulasekharam in Kanyakumari district of Madras State. Not only that. The nuts yielded by the variety grown here possess all the characters that go to make quality.

There are two main varieties of coconuts in India—the commonly cultivated tall, and the dwarf. The tall is hardy, attaining a height of 40 feet or more. It begins to flower in seven to ten years after planting and comes to normal bearing about five years later. A good palm may yield 100 nuts or more per annum, which will give about 30 pounds of good quality copra with about 72 per cent of oil.

The dwarf type, on the other hand, is very delicate, attaining a height of 15 feet and rarely living beyond 35 years. It is highly susceptible to insect pests and also fungoid diseases. It is early-bearing, commencing to yield in the third or fourth year of planting. The average yield may be about 60 nuts which may give five to ten pounds of thin, leathery, inferior quality copra containing about 66 per cent of oil. Due to its early-bearing nature, ornamental value and dwarf stature, people are showing increasing interest in its cultivation, but to be economic for growing on a plantation scale, a dwarf form must also possess good nut quality. The variety introduced by the New Ambadi Estate seems to fulfil this requirement.

This Estate is situated at the foothills of the Western Ghats, just 30 miles north of Cape Comorin. The soil here is good clayey loam having subsoil moisture in summer. The rainfall is abundant, both during the South-west and the North-east monsoons. Of the 500 and odd acres under coconut, the dwarf variety is being systematically grown on 35 acres. The planting was done in 1934-36 by the Triangular Method with a spacing of 20 ft. × 20 ft., giving 110 trees to the acre.

Three forms—red, yellow and green—distinguished by the colour of foliage and nut are being grown. In the green form, trees with round or oval nuts are also recognized; the former is reported to have been introduced from Antara Estate in Ceylon, and the latter from Banjar Estate, also in Ceylon. The red form is known as *Torkinton Red*, perhaps after an estate of the same name from which it was introduced. The yellow form again is an introduction from Banjar Estate.

The red and the yellow forms are more or less similar in most respects except for their colour. Both are of short stature, growing to a height of only eight to nine feet in about 15 years, and are reported to have come to bearing in four years after planting. The green forms are a bit taller—16 to 18 feet, and produce slightly bigger nuts than the other two forms.

The copra content of these dwarf introductions from Ceylon compares favourably with that of the tall variety commonly cultivated in India, as seen above. It is quite likely that there are good dwarf varieties in other countries also, which could be successfully introduced into India.

	Ordinary varieties in India			*Introduced varieties*			
	Dwarf green	*Dwarf orange*	*Tall*	*Dwarf green from Antara Estate*	*Dwarf green from Banjar Estate*	*Dwarf yellow*	*Dwarf red*
Girth of the nut in inches	13.5	15.00	22.00	22.32	19.84	19.20	18.64
Thickness of the kernel in inches	0.30	0.30	0.50	0.40	0.40	0.40	0.392
Copra content of the nut in gm.	92.14	99.23	170.10	210.00	180.00	175.00	143.00

2, 4-D

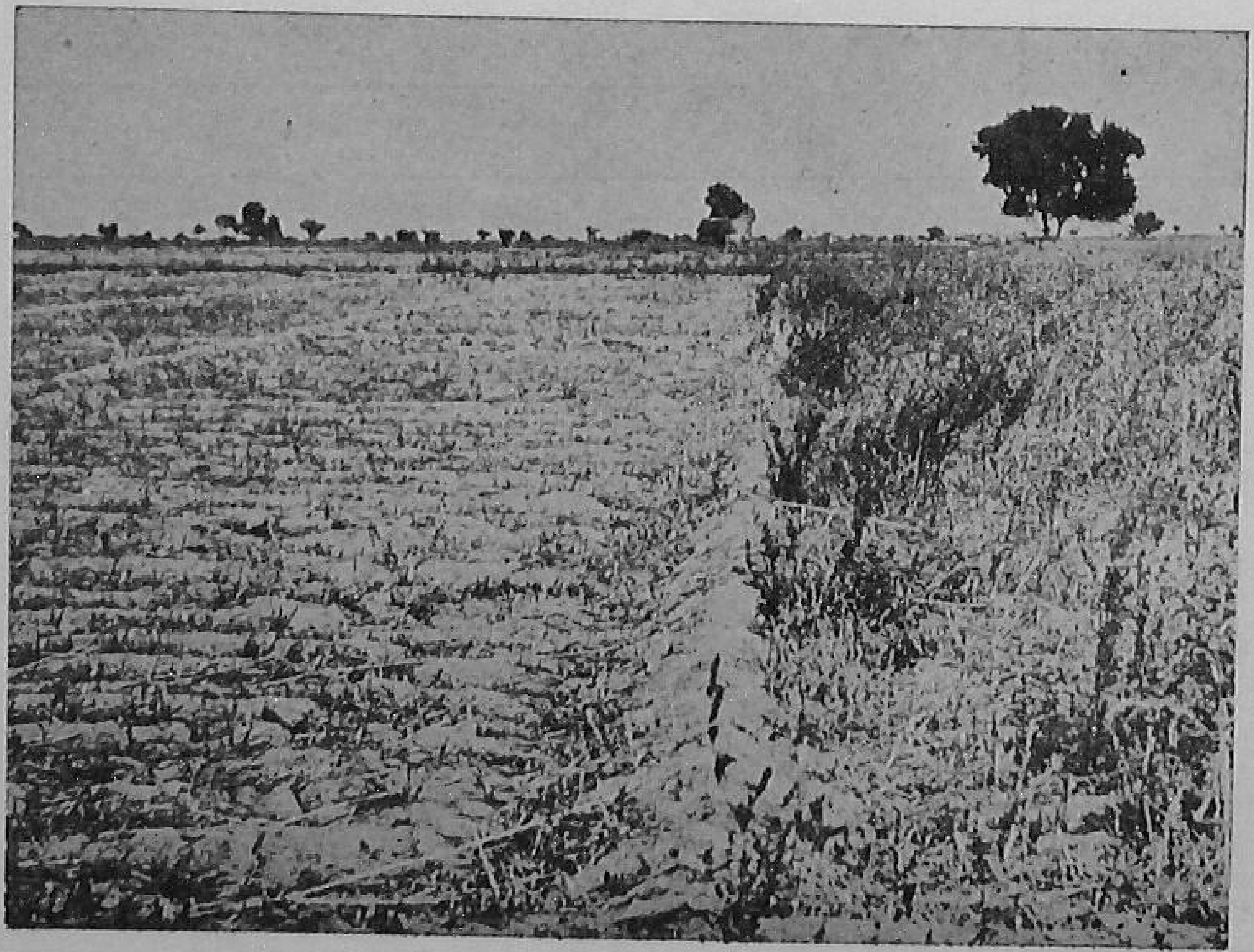
the answer to weeds in wheat fields

by
R.D. Verma, R.B.L. Bhardwaj
and
A.R. Khan
Indian Agricultural Research Institute, New Delhi

RECENT research in the Agronomy Division of the Indian Agricultural Research Institute, New Delhi, as well as in other parts of India and abroad, has conclusively shown that the common *rabi* weeds of cereals such as *bathu* (*Chenopodium album*), *piazi* (*Asphodelus tenuifolius*), *hiran khuri* (*Convolvulus arvensis*), *pitpapra* (*Fumaria parviflora*), *pohli* (*Carthamus oxyacantha*) and *krishn nil* (*Anagallis arvensis*) can be very efficiently and economically controlled by the use of that wonder chemical 2, 4-D (2, 4-Dichlorophenoxy acetic acid).

It is well-known that weeds cause enormous losses in crop-yields. In cereals, these losses may range from five to 40 per cent, depending on factors such as the weed species, the intensity of infestation and the fertility of the soil. Even at a conservative estimate of ten per cent, this loss in the wheat crop alone amounts to nearly 0.8 million tons valued at 313 million rupees annually. Obviously, we can ill-afford this colossal drain on our food resources.

A 2,4-D-treated wheat field after harvest of the crop. The portion on right was left untreated.



While cultural methods of weed control, such as hand-weeding or hoeing by other means, suffer from some inherent disadvantages, the control of weeds by chemicals is free of these drawbacks. For instance, weeding by implements cannot be done too close to the plants for fear of damaging them. Some weeds thus escape destruction and serve as a source of infection in the succeeding years. Hoeing is also likely to bring more deeply-buried weed seeds to the surface layers of the soil, where conditions are more favourable for germination, and thus, to some extent, defeat the very purpose of this operation. Weedicides, however, can be applied to weeds growing in, as well as in-between, the crop rows. Because weedicides are applied without disturbing the soil, there is no chance of new weeds coming up once the old ones have been destroyed.

Further, it has been shown by research workers all over the world that inter-row cultivation in close-row crops like cereals is liable to damage the root system, and thereby give a setback to the crop. No less an authority than Sir William Ogg, former Director of the famous Rothamsted Experiment Station, U.K., has stated: "Hoeing and other surface cultivations, though of great value in killing weeds, are, however, apt to damage the roots of crops and should be restricted to the minimum necessary for weed control." Therefore, if the weeds can be successfully controlled without in any way disturbing the root system,

it would be a distinct advantage.

DELHI TRIALS

Demonstrations were conducted during the *rabi* of 1956-57 and 1957-58 on cultivators' fields in Delhi State, in the villages covered by the Intensive Cultivation Scheme of the Indian Agricultural Research Institute, New Delhi. Spraying of 2, 4-D in both the years was done at the rate of one pound (acid equivalent*) in 60 gallons of water with a foot sprayer, six weeks after the crop had been sown. The weed count as well as the weight of the weeds was recorded when the weeds were at the height of their growth, that is, about six weeks before harvesting the crop. The effectiveness of 2, 4-D as a weed-killer in the wheat crop is indicated in the above Table.

(Per four square feet)

Weeds	*1956-57*				*1957-58*			
	Population		*Fresh weight in gm.*		*Population*		*Fresh weight in gm.*	
	Control	*Treated*	*Control*	*Treated*	*Control*	*Treated*	*Control*	*Treated*
Bathu	13	4	82	12	41	2	95	3
Piazi	131	14	398	22	121	3	253	3
Others	38	3	81	4	17	1	29	1
Total	182	21	561	38	179	6	377	7

It will be seen that, compared to the total number of 182 and 170 weeds in the control plots, there were only 24 and six weed plants left in the treated plots in 1956-57 and 1957-58, respectively. Though the chemical proved very effective against both the dominant *rabi* weeds, i.e., *bathu* and *piazi*, of the two, *piazi* appeared to be more susceptible to it.

Whatever weeds were left unkilled in the sprayed plots do not really represent the ineffectiveness of the weed-killer; part of the surviving weed population is attributable to the human factor. During the spraying operations, if the operator has not been very thorough, a few plants may escape contact with the weed-killer. It has also been found that more mature weed plants, though seriously affected by the chemical, may still manage to survive in a very stunted and deformed state. These plants, however, hardly offer any competition to the crop. This is quite clear from the fresh weight of the weeds from the treated and untreated plots: the average weight of the surviving weeds from the treated plots was reduced to almost half that of the same weeds from the untreated plots. Lastly, a majority of the surviving weeds generally consist of grasses which are unaffected by this chemical.

The Table below shows the benefit of an effective weed control with 2, 4-D.

In both the years, the average increase in grain yield has been more than 20 per cent, or a gain to the farmer of 3.7 and 2.7 maunds per acre in 1956-57 and 1957-58, respectively.

Year	*Yield of grain (mean per acre in maunds)*		*Increase over control*		*Net profit‡ (Rupees)*
	Control	*Treated*	*Md.*	*Percentage*	
1956-57 mean of six demonstrations	15.6	19.4	3.8	24.3	45.38
1957-58 mean of 23 demonstrations	12.7	15.4	2.7	21.3	29.98

‡ Price of wheat is taken as Rs. 14 per maund: sodium salt of 2, 4-D (80 per cent acid equivalent) at Rs. 3.1 per pound; cost of spraying 2, 4-D (labour charges only) at Rs. 4.00 per acre (two men at Rs. 2 each).

ECONOMICAL TOO

That 2, 4-D is not only very effective in weed eradication, resulting in increased yield, but is also very economical to use, is evident from the net profit figures: on an average, Rs. 45.38 in 1956-57 and Rs. 29.98 in 1957-58.

Perhaps the only stumbling block in the rapid and widespread adoption of this effective and economic method of weed control is the practice of sowing, after every six to ten rows of the main cereal crop, a row of a secondary crop like mustard which is sensitive to 2, 4-D. This problem can be overcome if the cultivators plant their requirements of the secondary crop separately

CONTD. ON PAGE 32

* The acid equivalent is always stated by the manufacturers of proprietary products. How much of the commercial chemical has to be used to supply the recommended rate of application expressed in terms of acid equivalent, is calculated from the following formula.

Multiply the rate (acid equivalent desired to be used) by 100 and divide it by the percentage of acid in the given product (as stated by the makers of the product). For example, if the product contains 80 per cent acid, the actual quantity of the product to be used to obtain one pound acid equivalent per acre in application would be $\frac{1 \times 100}{80} = 1.2$ pounds.

WHAT'S NEW IN FARMING

FERTILIZING PADDY

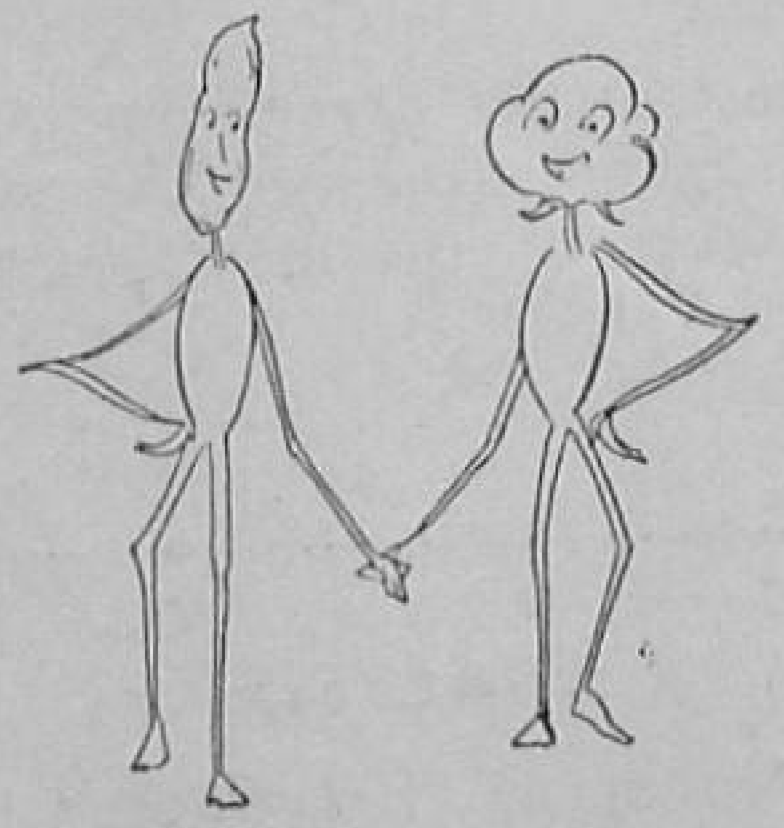
THAT it is not nitrogen alone that can always help increase paddy yields, is clearly brought out in the recent experiments conducted at the Paddy Research Station at Tissuhi (Mirzapur) in Uttar Pradesh. The Station has a black soil which is typical of the south-eastern part of the State.

In experiments at the Station, the paddy crop gave a higher yield when phosphate was applied to the crop than when nitrogen was applied. It was found that a good manurial dose for paddy in such a soil was ten pounds of nitrogen applied in two doses and 40 pounds of phosphoric acid applied at the time of the last ploughing.

MIXED CROPPING PROFITABLE

AN example of how mixed cropping is advantageous comes from the Punjab, where cotton and groundnut are commonly grown mixed. Last year, when the cotton crop failed due to heavy rains in September-October, the heavy losses farmers would have incurred as a result were offset by a good harvest of the groundnut crop grown mixed with it.

Mixed cropping has also been found paying in recent experiments in Andhra Pradesh and Mysore. In the Guntur District of Andhra Pradesh, a mixed crop of cotton with chillies and groundnut gave more profit than a pure crop alone. The additional profit from an acre of the mixed crop varied from Rs. 21 to 93.



Similarly, in Dharwar in Mysore, a *Laxmi* cotton crop grown mixed brought in more profits without any bad effects on the quality of the cotton produced than a pure *Laxmi* crop.

In the western tract of Andhra Pradesh and the adjoining area of Mysore State, three million acres are put under *Setaria* and groundnut every year. Farmers could as well grow cotton in mixture with these crops, it is pointed out. This can easily increase our cotton production by three lakh bales a year.

PLANTING SWEET POTATO

THE top portion of the sweet potato vine is better than cuttings from other portions of the vine for planting purposes. This, it is observed, is because the middle and bottom cuttings of the vine have a harder skin, which prevents quick and satisfactory rooting when planted.

These are some of the hints given to Sholapur (Bombay State) farmers for getting better sweet potato yields.

Cuttings for planting should be six inches long, and with three eye-buds. Only such vines as are free from the sweet potato weevil should be selected for planting to avoid weevil trouble in the field later.

For raising a bumper crop, a manurial schedule is also recommended: ten cartloads of cattle manure or compost per acre, and topdressing the crop with a mixture of equal parts of ammonium sulphate and groundnut cake to supply 40 pounds of nitrogen. The topdressing is done when the crop is 1½ to two months old.

FIGHTING BLAST DISEASE

BLAST is one of the most serious diseases of paddy in Madras State. But, strains recently evolved not only have resistance to the blast disease, but also yield high.

The need for evolving these new strains arose because *Co. 13*, the short-duration (110 days) variety and *G.E.B. 24* (150 days' duration), which are the most widely grown varieties, were found to be growing more and more susceptible to blast attack.

The new strains just now are identified by the numbers *6522* and *6538*. *6522* has the same duration as *Co. 13*, but gives a higher grain yield and is resistant to blast. The other strain, *6538*, matures in 165 days (as against 150 days of *G.E.B. 24*), yields higher, and is blast-resistant.

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AUSTRALIAN FARMING AS I SAW IT

by

Harcharan Singh Brar

RECENTLY, I had an opportunity of studying Australian agriculture, and of working side by side with Australian farmers as one of the Colombo Plan Indian farmers' group. This study tour gave me a chance to know how Australian farming differs from Indian farming. Agriculture in Australia is fully mechanized, because, firstly, their average holding is much bigger than ours—the average wheat farm being of the size of 2,000 acres, while in India it is hardly five acres; secondly, the country is self-sufficient in agricultural machinery.

I have come back with the definite view that unless something very drastic is done in agricultural research and the dissemination of its results among farmers, our progress in solving the food problem will continue to be very slow. It seems to me that we are still far behind in scientific research. I do not think I would be wrong if I say that we are not spending as much money on agricultural research as we should. India will be able to feed her ever-increasing population only if we adopt the latest scientific methods to restore soil fertility, check erosion and, above all, make agriculture a more permanent vocation. Also, there has to be a two-way traffic: not only should the information from the laboratory be carried to the farmer, but the farmer's problems, experiences and needs should also be brought back to the laboratory for further investigation.

MORE LABORATORIES

In my opinion, we should have an agricultural research laboratory at every tehsil headquarter. These laboratories should carry on research relating to field crops, both dry and irrigated ; crop improvement by plant breeding, strain selection and seed certification ; breeding, feeding and management of livestock, control of animal diseases, registration and distribution of pure-bred bulls, elimination of tuberculosis in cattle ; fruit culture, general orchard management, pest and disease control, fruit packing and fruit preservation ; and soil and water analysis. Advice to the farmer should be one of their important functions.

Here, I would like to give a very good example of what proper research can do. In southern Victoria, there was an area about 100 miles long and 50 miles wide which received very good rainfall, but was completely barren and bare. Soil chemists started working on this area and found that there was a deficiency of molybdenum (a trace element) to the extent of two ounces per acre. It was a problem for them to spread two ounces over an acre. What they did was to mix it with other fertilizers and apply it to the land. Believe it or not, these two ounces of molybdenum per acre converted the whole desert into a very fertile land. It changed the entire pattern of the area from very poor grazing to mixed farming. In that area, cropping and stock-raising is now carried on very profitably.

One of the most important functions of the agricultural departments should be to bring the results of scientific research promptly to the farmers so as to reduce the time-lag between their discovery and adoption in the field. In Australia, field days at research centres and experimental farms attract a large number of keen and interested farmers and have proved to be a very effective medium of bringing research results to the farmer. Farmers' field days should be made a common feature in our rural areas and should be organized in various parts of the country by the states each year at departmental research stations as well as at progressive private farms.

COURSES IN FARMING

Short courses on improved farming techniques should be arranged for the farming community at agricultural colleges, where they should also be given instruction in grain storage, fruit packing and farm management. The latest scientific information should be brought to the very door of the farmer through mobile rural Extension units which should make use of the media of lectures, demonstrations and film shows. Bulletins, pamphlets and leaflets carrying useful results of research should be published by the State Agriculture Departments in regional languages and distributed free of cost among the farmers. Special rural broadcasts should be made a more frequent feature of our radio programmes.

AGRICULTURAL SHOWS

Agricultural shows are another good way of improving the farmer's knowledge. I was lucky enough to see the Royal Melbourne Show at Melbourne, at which I learnt a great deal about Victorian agriculture and the social and cultural activities of the State.

In the agricultural hall at the Show, officers of the Government, with the help of exhibits, gave advice on problems of soil erosion, pasture improvement, pest control, fodder conservation and the hundred-and-one other things which worry the farmers. The most wonderful thing about these shows is that they are entirely run, managed and financed by the farmers, breeders and graziers. Such shows are held in every state in Australia at the state as well as the district level. The magnitude of the Melbourne Show can be gauged from the fact that its budget was round about a million rupees.

MARKETING BOARDS

Another thing that struck me was the marketing of agricultural produce through the marketing boards of the Australian Stabilization Scheme. The state stabilization plans are executed through the State Marketing Boards. With the help of these boards, the Australian Government has completely eliminated the middleman.

Such a Stabilization Scheme and marketing boards could very well be introduced into India also, where the middleman still holds sway. Such a scheme would infuse a feeling of security and confidence among the producers. It would also provide them reasonable protection against price instability of farm products from season to season resulting from the activities of the middleman. This would undoubtedly encourage the producers to produce more. In my opinion, co-operation at the selling and buying level can work wonders.

Wheat, citrus and dairy farming were the special subjects of my study in Australia, and briefly I give below my impressions about these.

Generally speaking, the Australian soil is much poorer than the Indian soil, but still the per-acre yield in Australia is higher. Wheat in Australia is grown on dry farms, having an annual average rainfall of ten to 20 inches. Eradication of weeds is given the first importance. The aim of every farmer is not only to have a heavy crop from his land, but also to build and maintain the fertility of the soil.

WHEAT

The usual rotation on the wheat farm is pasture—pasture—fallow—wheat. When a farmer is sowing

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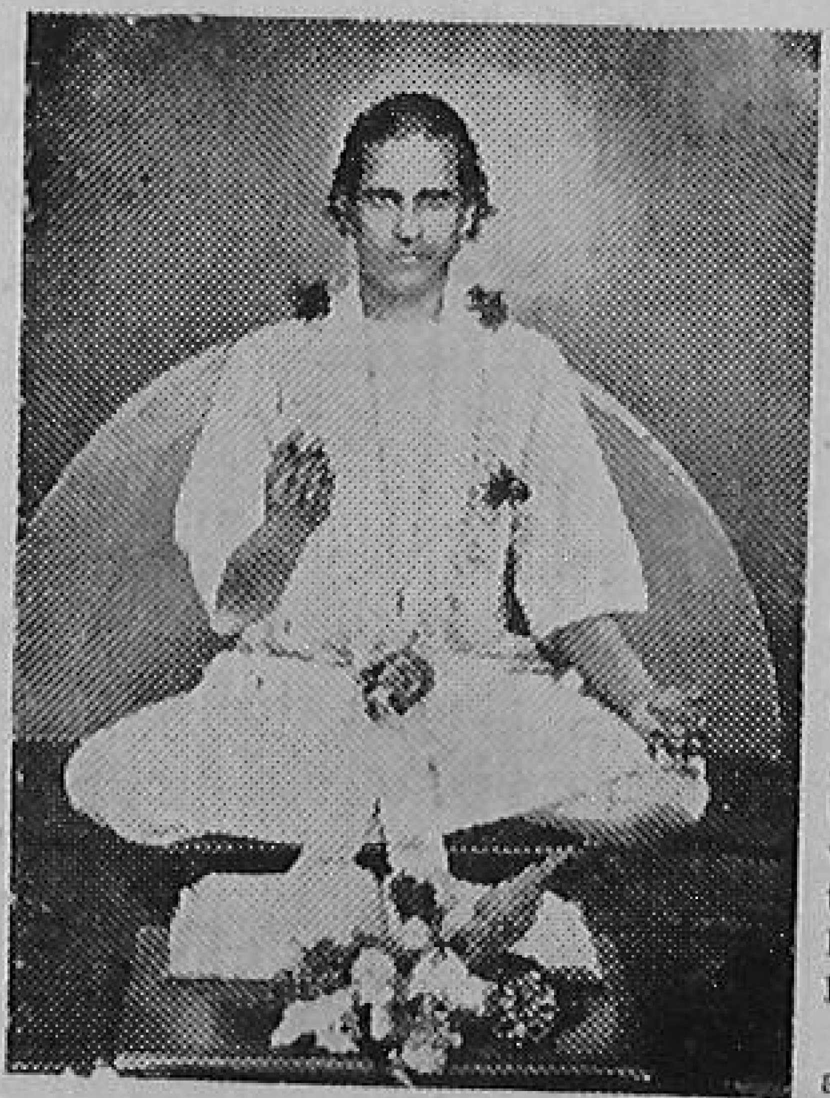

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his wheat crop, he mixes five to six pounds of clover seed with the wheat. The clover grows side by side with the wheat crop and sheds its seed in the field. When the wheat is harvested and the first rain falls after the harvest, a beautiful crop of clover comes up and the farmer lets his sheep on to it.

It is perhaps surprising that the Australian farmer can afford to keep his land under pasture for such a long time. But he does not lose on this account. On the contrary, he earns money through meat and wool, as well as builds up the fertility of the soil with the help of clover, which is a legume. Again, the urine and droppings of the animals which graze on the land enrich the soil. There are approximately 45,000 wheat farms in Australia, and about 60,000,000 sheep.

Systematic marketing of wheat through the Wheat Board brings fair returns to the Australian farmers. The Board is a monopoly organization run by the producers, which has replaced private enterprise in the field of wheat marketing. Its efficiency is generally acknowledged, the administrative costs being relatively low. The profits are handed back to the producers. Through legislation, a levy of 1/4 d. per bushel is charged on all wheat delivered to the Wheat Board. This levy is utilized for expanding research into the various factors associated with wheat production, one of which is the breeding of varieties more resistant to the rust disease.

CITRUS-GROWING

Most of the citrus production in Australia is in the area adjacent to the Murray River in New South Wales, Victoria and South Australia, and in the Murrumbidgee Irrigation Area of New South Wales. The oranges raised are exceedingly green ; the most popular varieties are *Valencia* and *Washington Navel*. As in other lines of farming, citrus growers are organized into many organizations and federations which look after the marketing.

A lot of research is done on every aspect of citrus-growing: planting methods, root-stocking, fertilizers, cover crops, inter-cultivation, grading, wrapping and packing of fruits, and various pests and diseases. I shall give an example of an improved method of planting. Usually, the row-to-row distance as well as the plant-to-plant distance is kept at 20 feet. But in Australia, for the first 15 years, they keep a distance of 20 feet from row to row, but ten feet from plant to plant. This way, they plant an extra tree in between. After 15 years, when the plants require more space, they pull out the one in the middle.

Dairying is the third most important industry in Australia. With dairying, they make the most of the land. One out of every 25 Australians is employed in some branch or other of the dairy industry.

HIGH MILK PRODUCTION

Their dairy cow is much more efficient than ours. There are about 3½ million dairy cows which produce 1,500 million gallons of high-quality milk worth more than £150,000,000 each year. The main breeds are Jersey, Frisian, Ayrshire, Guernsey, Red Poll, Dairy Short-horn and the Australian Illawarra Short-horn. Here is an example of the standard of milk production. A cow of Guernsey breed completed her 12th lactation in June, 1958, at the age of 14 years and seven months with 14,865 pounds of milk testing 4.81 per cent and 715 pounds of butter-fat. Her aggregate milk yield in 12 lactations was 149,792 pounds averaging 5.89 per cent test and 8,792 pounds butter-fat.

All the big cheese and butter enterprises are organized on a co-operative basis. A lot of research in the manufacture of dairy products, growing of pasture and cattle breeding is done, and new products are evolved to prevent waste and to reduce the manufacturing costs. Rinderpest and foot-and-mouth of cattle have been completely eradicated. Work is also being done to find out what feeds induce the highest milk production.

I was particularly attracted by a summer fodder crop called Russian Comfrey. It gives five to six cuttings. I think we, too, could have this fodder crop ; some cuttings of it I brought with me are growing very well on my farm.

To sum up, the things that impressed me most during my Australian tour were their efficient marketing system, adequate attention to scientific research, their effective methods of conveying the results of research to farmers, and last, but not the least, the fact that unlike us, their approach to their agricultural problems is scientific and economic rather than sentimental, religious and political.

CONTD. FROM PAGE 13

Sugarcane Irrigation

These are as important as manuring or irrigation. Experimental results have shown that with the same number of irrigations, the yield of unhoed plots suffers as compared to plots with proper hoeing and interculture. In one experiment, it was found that in shallow planting and with proper hoeing, an irrigation after planting gave 12.5 per cent higher cane yield as compared to irrigation given before planting. Further research is required to establish correlations between irrigation and different cultural practices followed in the different regions of the State.

farm flashes

THE best spacing for *P. 216 F* cotton in the tank-fed rice fallows of Madras State is two feet between rows and six inches between plants, with two plants per hole. This gives an extra yield of 210 pounds of *kapas*, or an extra profit of Rs. 79 per acre, compared to the normal spacing of two feet × nine inches with one plant per hole.

THE wild species of groundnut are not only good fodder crops but also good soil-binders.

They produce plenty of roots, and cover the soil with great rapidity. They check soil erosion by covering the soil and binding the subsoil. They can tolerate a variety of soil and climate, but grow best in red sandy loams and soils rich in lime.

FIFTEEN seers per acre is the best seed-rate for the improved *K2* strain of linseed, and 32 pounds the best dose of nitrogen. An extra yield of 2.16 maunds per acre, or a net profit of about Rs. 22, is the result.

CONTROL the mustard aphid with five sprayings of 0.025 per cent "Parathion" suspension at ten-day intervals ; the dose, 100 to 175 gallons per acre.

THIRTY-FIVE to 45-year old, run-down or neglected coconut groves can be rejuvenated by using cover crops like the perennial Calopogonium and the tropical Kudzu. Within a year, they cover the whole soil, smothering all weeds. The yield of nuts in such plots is higher.

WHAT is your hatching percentage ?

A breeder incubating his own eggs from his own farm should not accept anything less than 85 per cent of all eggs hatched over the season.

To get good fertility, the males must be fit. Sleek plumage, not a stub or a bristle, well-feathered all over ; neat head, bright eye, flat back, strong round shanks, and above all, a friendly disposition—these are the signs of an ideal male.

HERE are some of the advantages of "confinement" rearing of poultry : less land is needed ; it is easier to keep accurate records ; there are fewer losses from predators.

PENICILLIN is a cheap treatment for bloat. When there is a possibility of bloat, gradually start feeding 50 milligrams of penicillin per cow per day and build up to 100 milligrams within three weeks. The treatment is effective for a month.

IN South Africa, they have found a new way of checking the mealy bug of grapes. Mealy bugs give off a sticky substance called honey-dew, which is much sought after by the Argentine ant. The natural enemies of the mealy bug, i.e., ladybird beetles and wasps, can work effectively only when these ants are absent. Soil application of "Dieldrin" in autumn effectively cuts down the ant population. Complete destruction of the mealy bugs follows in a year.

POULTRY manure is an excellent garden fertilizer, but has too much nitrogen in proportion to phosphate and potash. Balance it by mixing six pounds of superphosphate and one pound of muriate of potash (potassium chloride) with 80 pounds of poultry manure.

RESEARCH has started into an entirely different way of controlling the various insect pests which attack the cotton crop in Uganda. Instead of killing them with chemicals, scientists are trying to kill them with their natural enemies.

The lygus insect is one good example. The lygus is less than a quarter of an inch long and its parasite is smaller than a pinhead. Parasites of the lygus are being bred in a laboratory so as to liberate them on a cotton plot known to be pest-ridden.

A LAYER of coarse pebbles or road metal spread round the bases of coconut trees, fruit or ornamental trees keeps the soil surface beneath this "stone mulch" moist and does away with the need for frequent watering.

GOATLINGS do best if allowed to run loose together in a large, well-lit shed ; this way, they get more exercise than if the building is divided into boxes.

COMPARED with other animals, goats become heavily pregnant and their natural inclination during the gestation period is to stand or lie about, resulting in a poor condition.

Compel them to take some exercise, say, by taking them round the paddock for a short walk.

DELHI EXCEEDS RABI TARGETS

by

A.S. Sharma

As a result of the *rabi* campaign launched in October, 1958, production of *rabi* foodgrains in the Union Territory of Delhi went up by nearly 17 per cent as against the target of 15 per cent fixed by the Government. In spite of the late sowings due to rains in October, a total of 21,000 tons of wheat, barley and gram were produced, compared to an average of 18,000 tons during the past three years. Delhi has accordingly qualified for the Community Award of Rs. 50,000.

The entire Territory, comprising 305 villages, is fully covered by five National Extension Service Blocks, each Block having about 60 villages with a population of 60,000 to 70,000. Campaign Committees were set up at the State, Block and village levels for planning and executing the *rabi* production drive. While the entire Extension staff of the Development Blocks and the staff of the Development Department were mainly responsible for the implementation of the Campaign, 32 teams of "helpers" from the Indian Agricultural Research Institute, New Delhi, played an important part in urging the farmers to achieve the target fixed.

The programme of work included an assessment of the situation, arranging of timely supplies of seeds and fertilizers, cleaning of water channels and guls, plant protection measures and laying out of field demonstrations. The 600 cultivators in each of the 32 Village Level Workers' circles were, accordingly contacted by the expert teams.

Ordinarily, 50 per cent of the fields were well cultivated. The remaining 25 per cent were rapidly surveyed, the stubbles of the previous crops got removed and eight to nine ploughings given to keep down weeds.

IMPROVED SEED

The improved wheat varieties *N.P. 718* and *C. 281* were recommended to the farmers. *C. 281* being more popular, 3,200 maunds of seed of this variety were distributed. The farmers were advised to use 50 pounds of seed on irrigated land where white ant infestation was low. This not only saved seed, but tillering was heavy and there was no lodging. Line-sowing with a spacing of nine inches between rows was advocated. About 6,000 maunds of improved gram seed obtained from Ganganagar in Rajasthan were also made available to the farmers.

The Development Department arranged for the supply of 2,52,000 maunds of sludge manure and

A fine crop of *N.P. 78*, an improved variety of gram

Bansa (*Ipomoea carnea*) **was popularized for compost-making**

fertilizers. The farmers were advised to apply the manure six to eight weeks before sowing. For the irrigated areas, 15 to 16 maunds of compost manure and four to five maunds of chemical fertilizers per acre were the doses recommended. Stress was laid on green manuring. *Ipomoea carnea*, popularly known as *bansa*, was advocated for compost-making and preventing soil erosion.

As the improved wheat variety *C. 281* is a mid-season one and does not mature early, two irrigations with canal water after sowing and four well irrigations were recommended. A sum of Rs. 1.64 lakhs was spent on boring old wells and sinking new ones.

PEST CONTROL

Fields infested with white ants were dusted with five pounds of ten per cent or ten pounds of five per cent BHC dust. Ten to 15 pounds of five per cent "Aldrin" per acre were also advocated for the destruction of white ant colonies.

As rodents caused serious damage to the crops, a campaign for exterminating them was undertaken on a large scale. Three per cent zinc phosphide was recommended for baiting. Rats were completely destroyed in 75 villages and partially in the remaining ones. The village *patwaris*, village youths and children rendered great help in making this campaign a success.

As many as 200 varietal *cum*-cultural-*cum*-manurial demonstrations were laid out on the cultivators' fields. Each demonstration covered one-fifth of an acre. A new improved wheat variety, *N.P. 824*, which had earlier shown good results at the Pusa Farm, was also introduced. At a demonstration in a field at Mundaka village in the Kanjhawala Block, the average yield per acre of *N.P. 824* was of the order of 50 maunds 35 seers, i.e., 400 per cent more than the local average!

The work done by the officers and staff of the Development Department and the teams of helpers came in for appreciation when the Community Award was announced.

CONTD. FROM PAGE 24

2, 4-D

The space utilized for the secondary crop, whether sown mixed with wheat or separately, will be the same, but this change would be of great advantage to the farmer; besides being able to use 2, 4-D to control weeds, he would also have a better control over pests and diseases owing to the smaller, compact area under each crop.

Further, this would also obviate the loss which a crop like mustard with broad leaves can cause to the adjacent rows of wheat by its smothering effect. Harvesting operations also will be made much easier and cheaper if such pure cropping is practised.

If the necessary precautions regarding the proper dose, time of application and thorough application are observed, there is no reason why our cultivators should not be able to derive the full benefits from this wonder chemical 2, 4-D, as millions of farmers in other countries are already doing.

SOUTHERN REGIONAL CATTLE SHOW

The Southern Regional Cattle and Poultry Show will be held at Teynampet, Madras, from September 24 to 29, 1959. Cash prizes worth Rs. 15,000 and a large number of challenge trophies will be awarded to winners. Some highlights of the Show will be a bullock-cart race, a horse race, a draught test and a ploughing competition.

SPOTLIGHT ON EELWORMS

by

U. S. Mishra *and* **A. R. Chauthani**

M. B. College of Agriculture, Gwalior

EELWORMS (or nematodes) parasitic on plants are of great economic importance, causing enormous losses. According to Taylor (1953), in the U.S.A. alone, losses due to these parasites are of the order of several hundred million dollars.

Plant parasitic nematodes are very tiny creatures living in the soil. They range in length from 0.5 to 2.0 millimetres. Free-living forms are also found in the soil, but their food consists of decaying organic matter and bacteria ; they are distinguishable from plant parasitic forms by their enlarged buccal cavity generally having cuticularized hooks or teeth for holding and tearing the food. The parasitic forms live on various parts of plants and have a hollow protrusible spear (or stylet) for puncturing the plant cell-walls.

Plant nematology, as compared to human and animal nematology, has received very little attention in India. The only available references in India on the subject are those of Buttler (1913 and 1919) who ascribed the *ufra* disease of paddy to *Tylenchus angustus* in the paddy-growing tract of Bengal. His work on this species is quite informative. Rafay, Padmanabhan and Khanna (1942) have drawn attention to the injury caused by nematodes to sugarcane seedlings. Thirumalachar (1951) reported *Heterodera marioni* attacking potato in Simla, but the subsequent studies of Pushkarnath and Chaudhari (1958) show that various species of *Meloidogyne* are involved in gall formation on potato.

Of late, a vast amount of literature on the subject has been published in England and the U.S.A. In this connection, the work of Peters (1953) and Wallace (1954-58) on the migration of eelworms in the soil and the effect of various factors on the emergence of their larvae from the cyst is notable.

So far the following species of eelworms have been reported in India: *Anguina tritici* (Steinbuch, 1799) ; *Ditylenchus angusta* (Buttler, 1913) ; *Rhadopholus similis* (Cobb, 1893) ; *Meloidogyne incognita acrita* Chitwood ; *Meloidogyne javanica* (Treub) Chitwood ; *Meloidogyne incognita* (Kofoid and White) Chitwood. But the occurrence of other species cannot completely be ruled out because of the favourable climatic and soil conditions in our country.

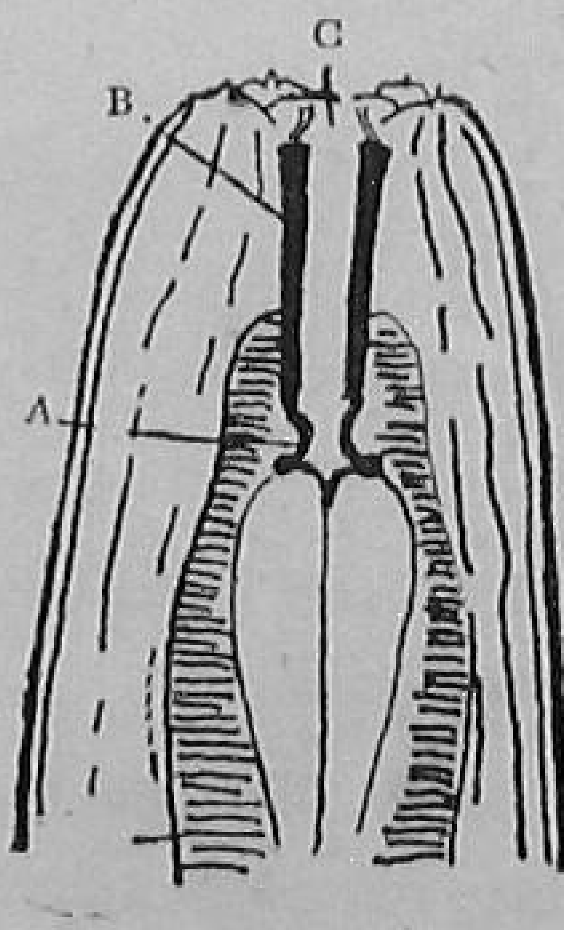
CLASSIFICATION

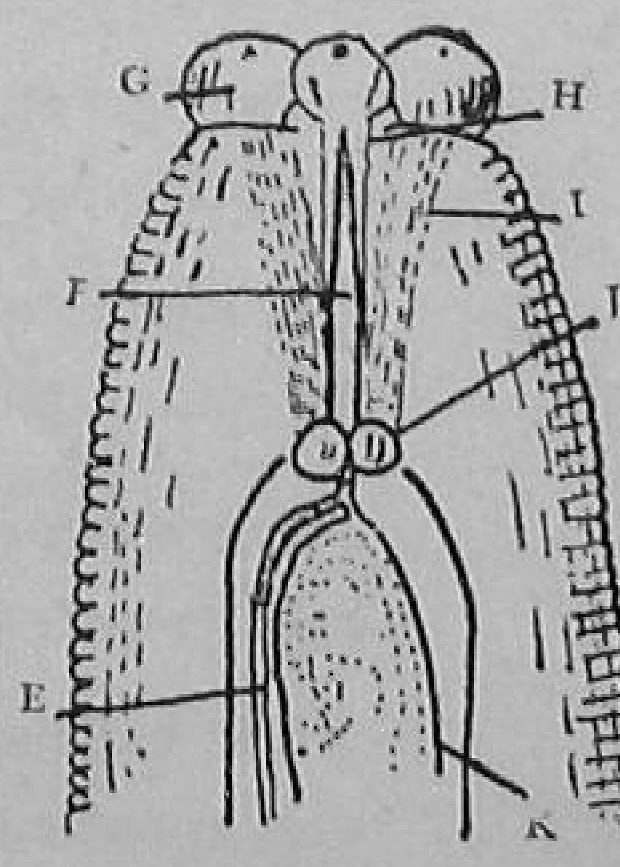
According to Hyman (1951), nematodes form a class of the phylum Aschelminthes which includes a variety of animals, e.g., rotifers, etc. But the most satisfactory classification is that of Chitwood and Chitwood (1950), which is generally followed by most nematologists ; the classification is as follows.

Phylum Nemathelminthes

Order *Phasmida* (*mainly parasites and soil forms*)
Classes Rhabditida
Tylenchida
Spirurida

Order *Aphasmida* (*mainly marine forms and parasites*)
Classes Chromadorida
Enoplida





Buccal capsule of

Rhabditis **(free-living)**

A. Telostom
B. Protostom
C. Cheilostom

Tylenchoid (phytoparasitic)

E. Duct of dorsal pharyngeal gland
F. Buccal stylet
G. Lips
H. Buccal capsule
I. Protractor muscles of buccal stylet
J. End-knobs of stylet
K. Pharynx

The end of the world

'THAT,' thought the hare, 'must surely be the Earth crumbling to pieces.' He had heard the thud of a fruit falling on dry leaves. 'I must run to save my life,' he mused.

He ran so fast that a deer, grazing in the fields, asked him, 'Why all this haste, brother?'

'Don't you know that the Earth is falling apart?' panted the hare. 'Save yourself! Follow me!'

The deer raced after him.

And soon they were joined by a buffalo, a wild ox, a rhinoceros, a tiger, an elephant and even a lion. In fact, the whole animal world followed them in a great procession.

They thundered on for miles and miles—until they were tired. Then the elephant began to wonder why there were no more signs of the Earth's collapse. So he asked the tiger: 'Brother Tiger, are you sure that the Earth is breaking up?'

The tiger stopped. 'Well, so the rhinoceros informs me,' he said.

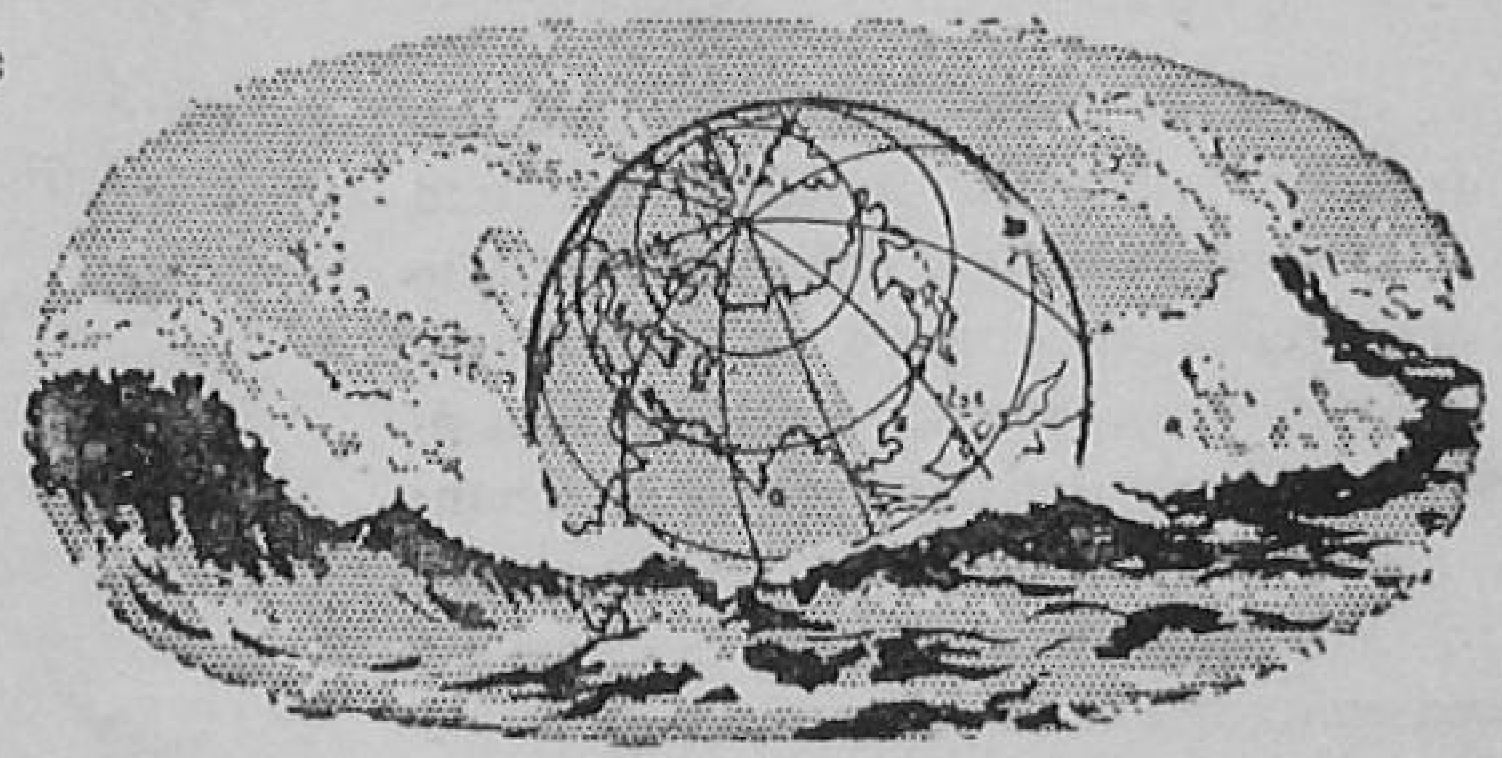
'I'm not sure,' cried the rhinoceros. 'Only, the wild ox tells me so.'

The wild ox bellowed: 'Don't blame me! I only repeat what the buffalo said.'

The buffalo pointed to the deer; and the deer mumbled: 'The hare started the story.'

The elephant trumpeted for the hare and asked: 'Well, Mr. Hare, who told you that the Earth was collapsing?'

'Nobody need tell *me*,' said the hare importantly. 'I knew as soon as I heard a sound like a thud. I thought it was certainly the end of the world.'



'You *thought* so,' laughed the elephant. And all the other animals went off, roaring with laughter.

MORAL of the story: Never listen to rumours when the facts are available and known. Consider DALDA. What are the true facts? It is an all-purpose cooking medium, made from pure vegetable oils—according to strict Government specifications.

For extra nourishment, 700 International Units of Vitamin A are added to every ounce plus 56 International Units of Vitamin D. Millions of housewives cook with DALDA Vanaspati because they know it is more than a cooking medium—that it's a *food*!

DL. 470-X 52

HINDUSTAN LEVER LIMITED, BOMBAY.

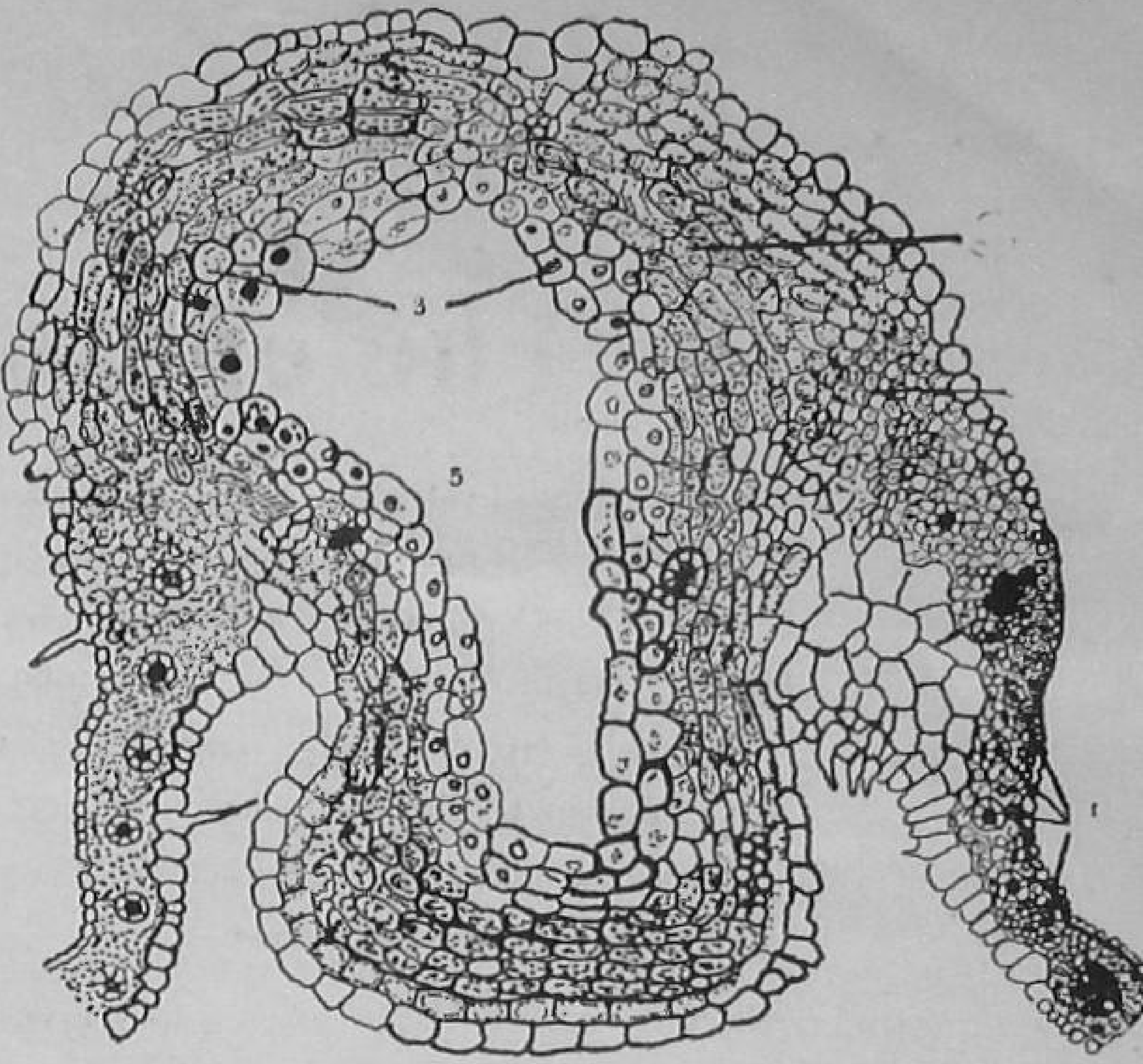
Most of the plant parasitic eelworms so far known belong to the families Tylenchidae, Heteroderidae, Criconematidae and Aphelenchidae, included in the order Tylenchida, and a few to the family Dorylaimadae of the order Enoplida.

GENERAL STRUCTURE

Eelworms are bilaterally symmetrical, unsegmented, usually bisexual, having a vermiform body circular in cross-section, a three-angled pharynx, circumcentric nerve ring, and copulating spicules. The mouth-opening is generally in the anterior face of the head. The latter in its most generalized form consists of six lips—two subdorsal, two subventral and two sub-lateral.

BIONOMICS

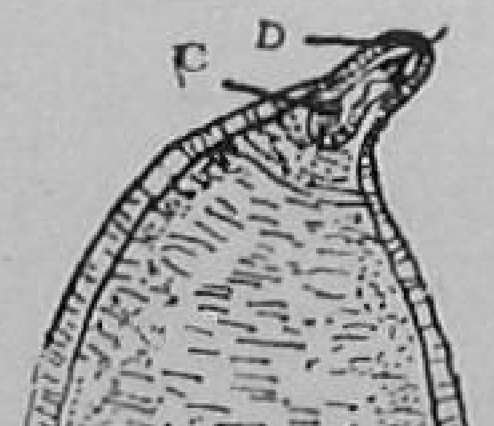
As stated by Peacock (1957), optimum conditions for plant growth are generally those best suiting the development of the plant parasitic eelworms. Thus, soil temperatures of 40°C and above are lethal to most eelworms, but low soil temperatures, even light freezing, are withstood by them fairly well. Adequate soil moisture is necessary for the movement and hence the development of eelworms, but some species may enter a dormant phase which is resistant to desiccation. *Anguina tritici*, the wheat gall eelworm, has been revived after 28 years in a dry condition, and *Tylenchus polyhynus* has survived for 39 years in a rye herbarium.



Gall formed by *Tylenchus cecidoplastes* in grass leaf

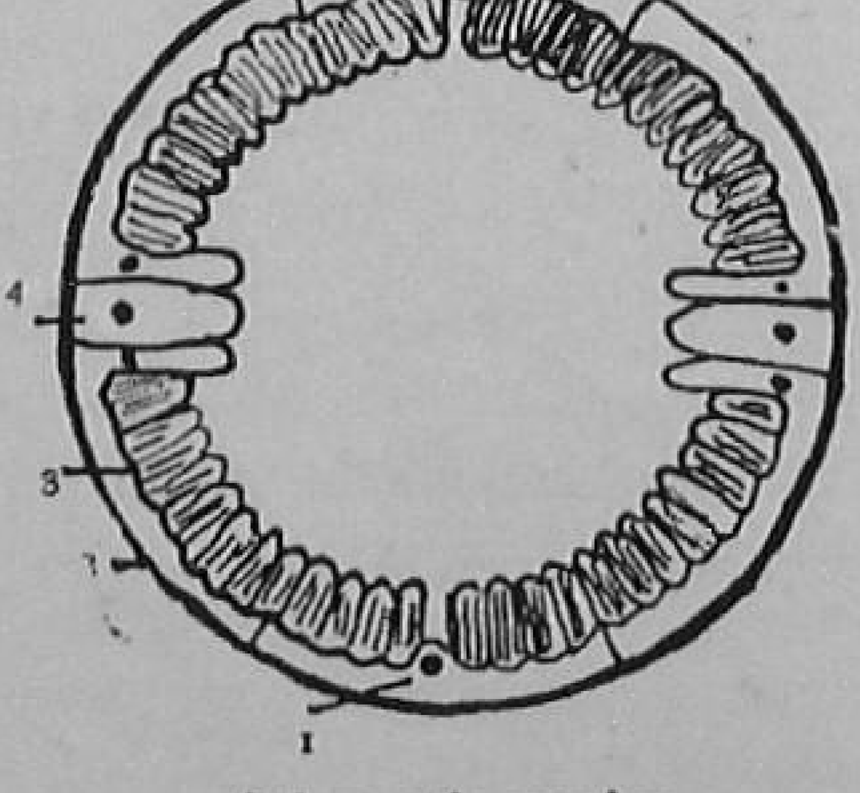
1. Vascular bundle
2. Sclerenchyma
3. Nutritive cells
4. Mesophyll cells
5. Cavity occupied by worm

Well-aerated light soils favour the growth and multiplication of root-feeding eelworms, whereas heavy soils and wet conditions are more suitable for the stem-feeding and leaf-feeding types. A soil *p*H of three to eight is well tolerated by most species.



Female of *Heterodera schachtii* exuding egg-mass

A. Egg-mass
B. Malva
C. Median bulb of pharynx
D. Spear



Schematic section across body of a nematode

1. Ventral chord
2. Cuticle
3. Muscles
4. Lateral chord
5. Dorsal chord

Generally, nematodes are bisexual, but in certain cases parthenogenetic and syngonic reproductions have been reported.

Phytoparasitic nematodes may be migratory or sedentary in habit. Their life-history involves four to five moults affecting the skin and the cuticular appendages. In most cases, the second juvenile stage is the infecting stage. In the migratory forms, the juvenile forms resemble the adult in all respects except for lack of genitalia. But in the sedentary forms, which include cyst-forming and non-cyst forming species (*Heterodera* spp. and *Meloidogyne* spp., respectively) they become differentiated at an early stage; the female gradually loses its worm-like form, becoming flask-shaped and ultimately spherical.

The migratory eelworm may get enclosed in the galls formed in place of normal seeds and can remain dormant for as long as 30 years, e.g., *Anguina tritici*.

In the females of the cyst-forming species, the body wall enclosing the eggs helps in resisting unfavourable conditions. In this resistant stage, they can withstand abnormal conditions as long as ten years. Under favourable conditions, due to the action of certain chemicals diffused from the host-plant roots into the soil

water, the larvae may hatch out and infect the plant. Thus the life-history is mostly prolonged in such species.

In non-cyst forming species, the eggs are laid in a jelly, either directly in the soil under favourable conditions, or enclosed in developing plant cells under unfavourable conditions. In the latter state, they are resistant to unfavourable conditions; in the former, they immediately hatch out and re-infect the plant, causing more damage than their cyst-forming allies.

SYMPTOMS AND PATHOLOGY

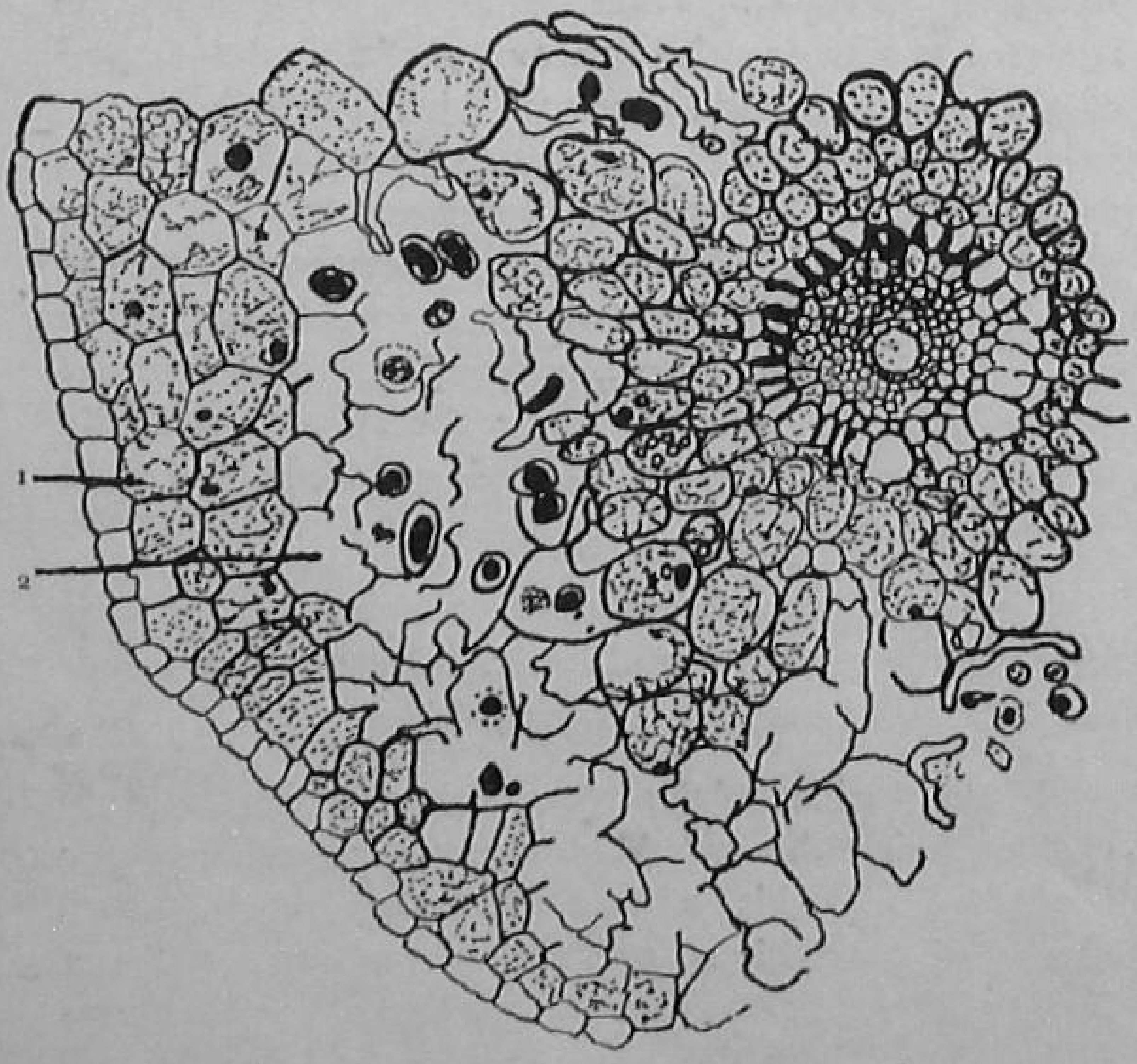
In general, eelworms weaken, but do not kill their host plant. Symptoms of attack are dwarfing, wilting, browning of leaves and (with some species) malformation of leaves, stem and roots. Eelworms are also the main cause for creating favourable conditions for many pathological diseases in plants.

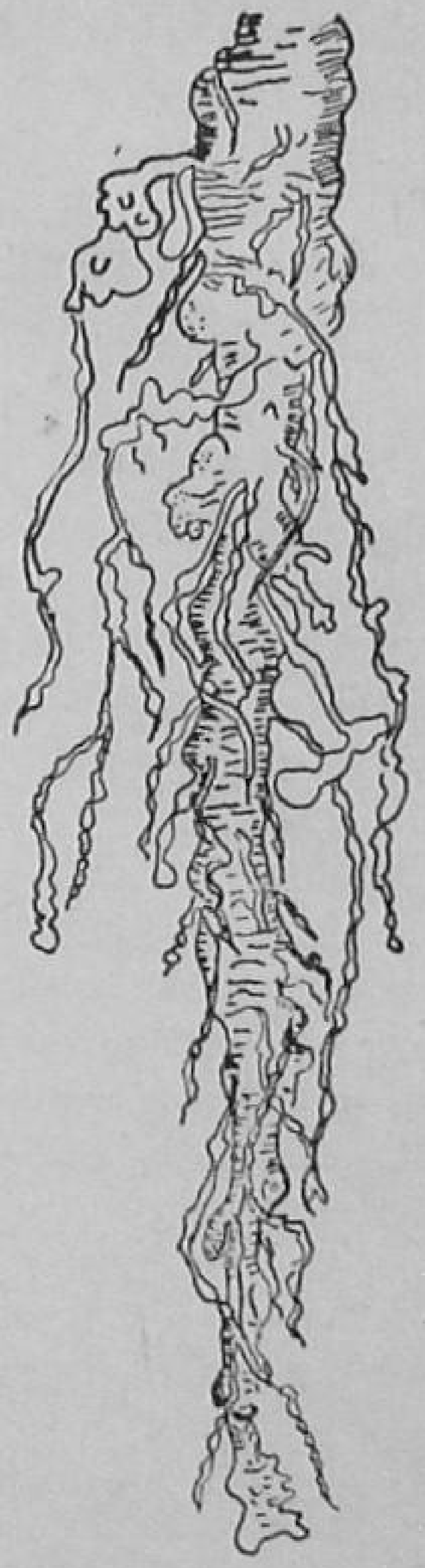
In the case of the cyst-forming, root-knot eelworms, no external swelling is caused. (The giant cells around the head of the nematode are formed from the surrounding cells by the dissolution of cell-walls, i.e., syncytia are formed.) There is no hypertrophy in the individual cells, nor do the cells undergo division.

In the case of non-cyst forming, root-knot eelworms, external swelling is caused by hypertrophy followed by increased cell-division and the formation of syncytia due to the dissolution of cell-walls adjacent to the head of the nematodes. As a consequence, the vascular bundles are blocked and parenchyma around the giant cells may become differentiated into disorganized vascular tissue.

Section across grass root gall caused by *Heterodera marioni*

1. Green tissue of leaf
2. Space occupied by worm





Roots of parsnip, showing galls caused by *Heterodera meloidogyne*

In the case of galls caused on leaf blades by *Tylenchus* sp., according to Goodey (1954) the causes are both the hypertrophy of the individual cells and the increase in the number of cells due to stimulation.

Thus, besides such morbid symptoms as wilting and leaf-drop, eelworms can cause root-knots (*Meloidogyne* spp.), seed galls (*Anguina* spp.), grotesque malformations of leaves and stems (some *Aphelenchoides* spp.) or simple terminal swellings of the root (*Xiphinema* and *Belonolaimus* spp.).

IMPORTANT SPECIES

Given on page 38 are the important species of plant parasitic eelworms. Some of them have already been

reported from our country; others are likely to gain entry in the event of quarantine measures not being strictly adhered to, specially in the case of materials imported from countries already having those species. The situation has become still more serious in the absence of any specific measures to rid the planting stock of nematodes.

CONTROL MEASURES

The control of plant parasitic nematodes is beset with many difficulties because of their soil-inhabiting nature, polyphagy and a prolonged dormant and resistant stage. However, the following measures are useful.

Cultural. Crop rotation and clean cultivation starve the parasite by eliminating its hosts. But most eelworms are polyphagous, and a few which behave as obligate parasites can enter a resistant stage when no food is required. Keeping the field fallow is quite uneconomical. Early planting, coupled with heavy fertilization so as to establish a strong root system, may result in the survival of the crop and by luxuriant growth may counterbalance the loss due to eelworms. But this would be preventive rather than curative, and cannot be practised for long. The use of pure seeds and unaffected transplanting material is very effective in certain cases. *Anguina tritici* can be completely controlled by purging the seeds of cockles by flotation in water. Shrivastav in Uttar Pradesh has found benzoic acid and salycylic acid in very low concentration (0·003 per cent) to be effective against this pest. The use of unaffected transplanting material is of prime importance, because the parasites have limited mobility to spread. All plants should be disinfected and the root soil of the galled plants should be dipped in hot water to preclude any possibility of infection. There is no variety of any crop which is resistant to all species of eelworms. The breeding of resistant varieties has met with little success. Nevertheless, the work of Ellenby (1954) on potato and that of Gilbert and McGuire (1956) on tomato is commendable.

Physical and Mechanical. Super-heating the soil to 140°F destroys all the stages of eelworms, but is applicable to small areas only. The use of bait crops entails many difficulties and cannot be widely used.

Biological. Of the various natural enemies of eelworms, the zoophagous fungi are the most notable, but their indiscriminate feeding habit, coupled with the difficulty of growing large numbers of them in the laboratory, is discouraging.

Fumigant	*Dosage*	*Limitations*
Chloropicrin (liquid)	200 lb. per acre, two to three times	(i) Cannot penetrate undecayed plant residues harbouring the parasite (ii) 60° to 80°F is the best range of soil temperature (iii) Costly, and hence can be used for high-value crops (iv) Water-sealing necessary
Methyl bromide 98 per cent mixture with two per cent chloropicrin (gas)	One lb. per 100 sq. ft.	(i) Can be used under covers placed over the soil, hence applicable to small areas (ii) Most expensive, useful for greenhouse or nursery fumigation
10 to 15 per cent mixture in xylene (liquid)	78 to 100 gallons per acre	(i) Expensive, otherwise good (ii) Water-sealing necessary
Ethylene dibromide 20 per cent (liquid)	15 gallons per acre	(i) Inflammable, but needs no water-sealing (ii) Cheap and good (iii) Can be used at 50°F soil temperature
Dichloropropene mixture 50 per cent (liquid); sold as D.D. soil fumigant	20 gallons per acre	Cheap and good, and can be used at as low temperature as 40°F

Chemical. The use of soil fumigants, though entailing many difficulties like high cost, careful handling and incorporation in the topsoil, has proved very effective. The Table above gives some chemicals and their limitations in use.

Liquid soil fumigants are injected or placed beneath the soil surface, usually six to seven inches deep, and sealed by sprinkling water to achieve the maximum effect; gas fumigants have to be used under cover placed over the soil. Since these chemicals are expensive, they should be used economically. Where crops are sown in close lines (less than 24 inches apart) or broadcast, the whole area has to be treated;

Species	Plant attacked	Disease caused	Damage and symptoms
Anguina tritici (Steinbuch, 1799) syn. *Anguillulina tritici* S. (Wheat-gall nematode)	Wheat and barley	Earcockles of cereals	The larva gets on to the growing tip in the early stage of the crop and causes galls in place of normal seeds ; hypertrophy of floral elements, stunting of ears and standing of glumes wide apart
Ditylenchus dispaci (Kuhn, 1857) syn. *Anguillulina dispaci* K. (Stem-and-bulb eelworm)	Sweet potato, oats, barley, sugarcane, wheat, peas, onion, garlic, tobacco, potato and clover	Clover sickness, tulip-root of oats, onion bloat brown-ring of bulbs	Localized deformation of stems and leaves, stunting and thickening of stems and twisting of leaves Swelling of hypocotyl in dicots and of leaf-base in monocots
Ditylenchus angusta (Buttler, 1913) syn. *Anguillulina angustus* B. (Paddy eelworm)	Paddy	*Ufra* disease of rice	Withering of leaves, shrivelling of grains in the stunted ears ; lower part of the glumes without grains
Ditylenchus radiciciola (Greef, 1872) syn. *Anguillulina radicicola* G. (Root-tip eelworm)	Oats, barley and wheat	—	Formation of galls at root-tips, yellowing of leaves coupled with stunting and deformation of plants
Tylenchulus semipenetrans (Cobb. 1913) syn. *Anguillulina semipenetrans* C. (Citrus root nematode)	Orange and grapefruit	Quick decline of citrus	Stunted growth ; complete degeneration of plants in heavy infestation
Pratylenchus pratensis (de Man, 1880) syn. *Anguillulina pratensis* d.m. (Meadow eelworm	Cereals, roots, cotton, coffee, tea and tobacco	—	Feeds on the cortex of the root and destroys the cells ; reddish-brown lesion on the root in the early stage, which encircles the root later and severs it
Rhadopholus similis (Cobb, 1893) syn. *Anguillulina similis* C. (Burrowing nematode)	Pineapple, canna, coffee, bamboo, sweet potato, banana and sugarcane; citrus in the U.S.A.	Spreading decline of citrus	
Heterodera schachtii (Schmidt, 1871) (Sugar-beet eelworm)	Cereals, roots, crucifers sugarcane, oats, lucerne, poppy, pea, potato	—	Formation of giant cells in the roots ; leaves change colour, become flaccid and finally die. Main taproot has a whiskered appearance due to excessive development of lateral roots.
Meloidogyne incognita acrita Chitwood *M. javanica* (Treub) Chitwood *M. incognita* (Kofoid & White) Chitwood (Root-knot eelworm)	Most crops	—	Formation of knots or galls on roots and tuber ; bushy appearance of roots
Aphelenchoides fragariae (Ritezema Bos, 1891) syn. *Aphelenchus fragariae* (Ritezema Bos, 1891) (Leaf eelworm)	Strawberry	Strawberry " bunch "	Both ecto- and endo-parasitic ; plants become deformed, leaves dwarfed. The entire plant becomes red.
Aphelenchoides cocophilus (Cobb, 1919) syn. *Aphelenchus cocophilus* C.	Coconut palm	Red ring of coconut	Affects both root and stem ; leaves become yellow and are shed ; nuts are shed prematurely
Belonolaimus sp. (Sting eelworm)	Maize, peanut, celery, strawberry	—	Ecto-parasitic, feeds on root tips. Reduced root system brown in colour. Seedlings are badly affected.
Trichodorus spp. (Stubby-root eelworm)	Maize, bean, beet and tomato	—	do.
Xiphinema spp. (Dagger eelworm)	Many crops	—	Simple terminal swellings of the root

but in crops sown in well-spaced rows, the actual rows and a little area round about will have to be fumigated. Thus, for crops sown in rows 24 inches apart, row fumigation will be worthwhile, and for orchards where rows are wide apart, strip or site fumigation is preferable. In strip fumigation, a strip of six to seven feet width for each row of plants is fumigated, while in site or spot fumigation the actual place where the transplant is to be planted is fumigated.

Experiments show that soil fumigation is very effective on light soils, while on heavy soils it is more or less ineffective. Muck and peat soils have to be treated with higher doses.

All the fumigants are toxic and hence should be handled with care. As all of them are also somewhat toxic to plants, they must be applied well in advance of planting to allow them to have their full effect and then diffuse out of the soil.

Leaf eelworms (*Aphelenchoides ritzema-bosi*) can also be controlled by repeated spraying with "Parathion" or systemic insecticides like "Demeton" or "Schradan."

Legislative. Local spread and new introductions can only be checked by prohibiting the importation of susceptible transplanting materials from abroad and from one state to another. As far as possible, the plant materials should be very carefully examined by experts before allowing them entry into the country.

The use of proper cultural practices along with the judicious use of chemicals will go a long way towards keeping down the eelworm population in the field. However, introduction of any new species from foreign countries will prove disastrous and has to be guarded against by strict quarantine laws.

MINERAL SUPPLEMENT

MANY animals do not improve in condition in spite of good feeding. This is often due to mineral deficiency in the diet. As the fodder in this country is often deficient in minerals, it is essential to add a mineral supplement to the feed to make up this deficiency, or allow the animals to lick their requirements from a mineral brick.

The following products are most suited for this purpose:

(a) **'Churn' brand Protective Mineral Supplement 105**—to be given mixed in the mash daily.

(b) **'Churn' brand Mineral Brick**— Each animal will lick whatever quantity it requires.

YOUR animals will improve in health and you will thus get better and more milk from your cows and goats, more and bigger eggs from your poultry and better work from your working animals.

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READERS WRITE

Punarnava

PUNARNAVA, a herb found commonly all over India, has ushered in a new era in the treatment of eye diseases.

The Ayurved Research Council, with headquarters at Delhi, experimented with a large number of preparations for treating eye-troubles during 1958; Punarnava proved the best of the lot. Its juice is to be applied to the eyes after soaking it in the powder of another herb known as Vimal Joti.

The herb has proved efficacious in eye troubles that were regarded incurable so far. Yet, it is so cheap that four seers of it would not normally cost more than an anna.

In many cases, it has made the use of glasses—whether of plus power or minus—unnecessary.

The application of the herb has disproved the existing belief that glasses once adopted, especially of the convex variety, can never be eliminated. In a large number of such cases, normal vision has been restored by the use of the herb.

According to the former Adviser on Indigenous Medicines to the Government of India—an authority on Ayurveda—the secret of his normal vision at the age of 60 is the use of Punarnava. The President of the Ayurved Research Council also tried it personally, and the specific enabled him to reduce the power of his glasses from +5 to +2.50. He has been wearing glasses for the past eight years.

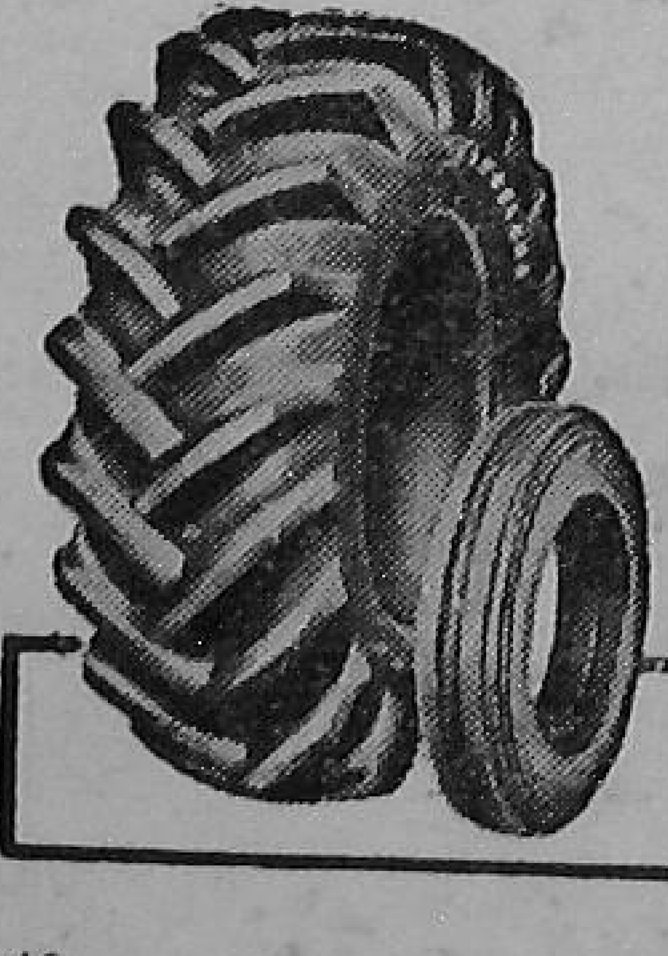
The Council is planning to open centres in the big cities, where the specific will be distributed free.

The Uttar Pradesh Government is planning to use the herb in the State Ayurvedic Hospital, Lucknow, and the Bharat Sewak Samaj, Muzaffarnagar, is arranging to distribute it in their various centres.

Secretary
Ayurved Research Council
Delhi

The Earth is his Heritage — Today's child-Tomorrow's farmer

Basic education and modern technology will help the farmer use his land to the best possible advantage for the benefit of his country, his sons and his sons' sons. Each successive year will see more and more tractors and implements assisting him in his productive labours. And all those tractors need tyres—Firestone tyres—for it was Harvey Firestone himself who made the first pneumatic farm tyre thereby opening up a better future for farmers throughout the world.



Firestone

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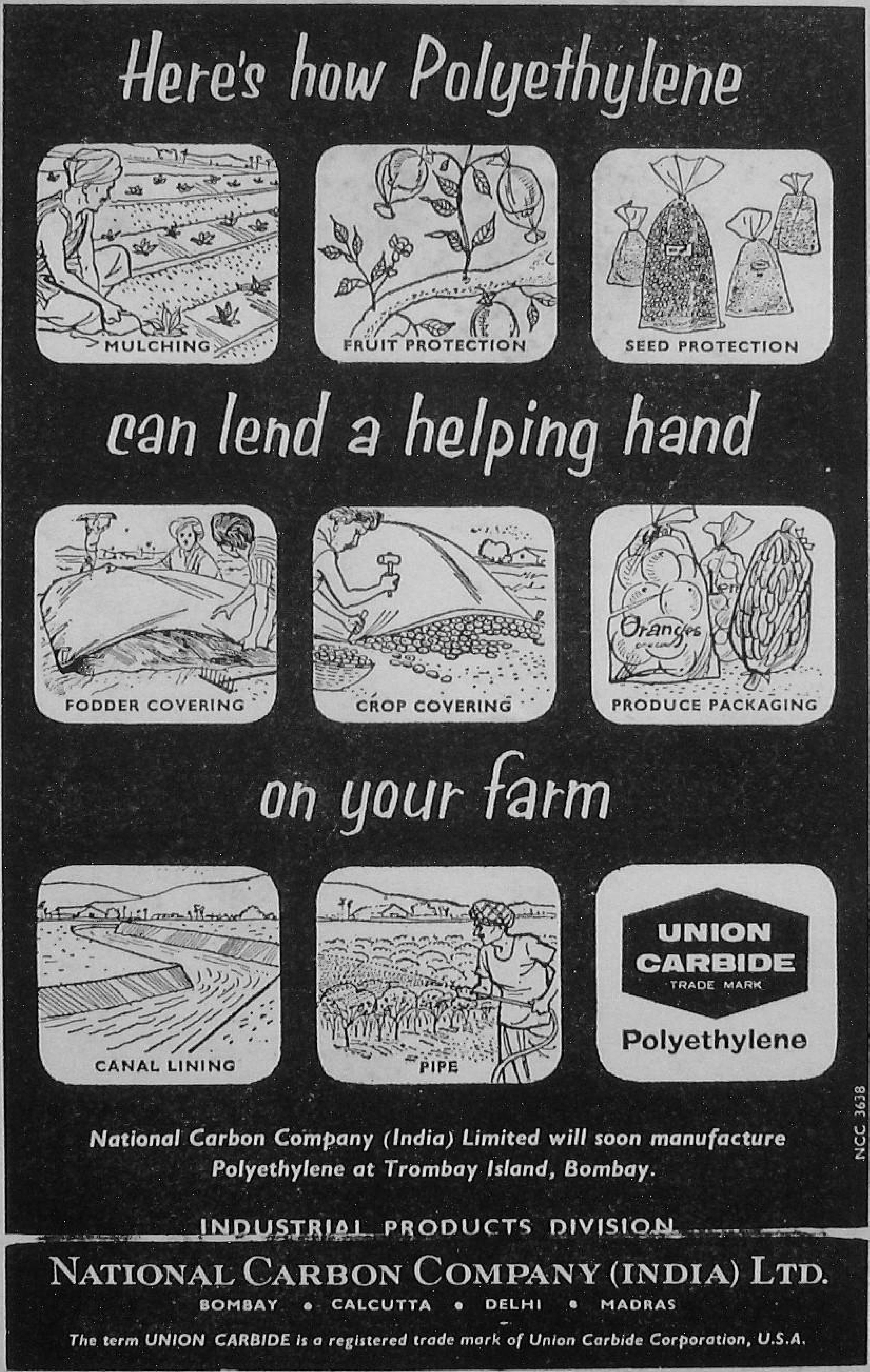
Support all activities of the Young Farmers Association, India, for a brighter future on the farm.



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